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AND NATURAL GASOLINE MANUFACTURER

Edited Monthly at Tulsa, Oklahoma

GRADY TRIPLETT, *Editor* GEORGE REID, *Associate Editor*

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A Standard Big Gas Engine

At least 90% of the power used on natural gas pipe lines during the past ten years has been Cooper 1000 H.P. engines. This engine has become standard for this service everywhere.

Although the demand for such equipment has always been irregular and never large, the fact that Coopers have been so widely accepted as standard has made it possible to keep their engineering development up-to-date and selling prices reasonable.

Four outstanding characteristics have resulted in retaining their position of leadership. First, they are accessible—operators like them. They are reliable to the point where many of their operating records seem unbelievable. They can be installed quickly and at a reasonable expense. Their operating costs—fuel, lubricating oil, labor and repairs—are low.

The C. & G. Cooper Company

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Mention Where You Saw the Advertisement

Another Market

ANOTHER market is in the making for the petroleum industry—the airplane. Just as the automobile came a generation back to demand fuel and lubrication, so the airplane stands today, ready to enter into big consumption of petroleum.

To the rank and file, the airplane today is either a novelty or an implement of danger. But the business of the world is looking upon the airplane as a means of further eliminating time in travel. By airplane, a point one hundred miles away is just an hour away in time.

As for safety, the makers and users of airplanes can show statistics that remove a lot of the natural reaction to flying. It must be remembered also that the automobile was once a vehicle of almost unspeakable danger.

Regardless of individual opinions, the airplane can today be accepted as a reality. So far as gasoline consumption goes today, that to be used in airplanes is negligible. But the demand for ten years from today defies calculation.

Demands for both fuel and lubricants may differ slightly for the airplane from that of the automobile. But the fuel and the oil for the airplane will come from the same barrel of crude oil, as do the fuel and lubricants for the automobile. The petroleum industry has the raw material and the manufacturing equipment in abounding quantities.

Selling conditions will differ and that is where the oil industry must adapt itself to this coming mode of transportation. The airplane does not demand a garage, service station or curb pump at each turn of its course.

It is to the credit of the Natural Gasoline division of the Petroleum Industry that it has taken the lead in furnishing the fuel for the airplane. Individual concerns within this branch of petroleum have led the way in determining the best fuel for the airplane motor. They are leading also in calculating acceptable methods of marketing.

The airplane seems to have given the Natural Gasoline industry a chance to make itself an entity within the petroleum family. Basically natural gasoline possesses desirable characteristics as a fuel for the airplane. Scientific effort within the Natural Gasoline business has been successful in extracting the choicest parts of the product for the airplane.

That the Petroleum Industry is aware of its possibilities with the airplane is evident from the fact that it is perhaps the foremost user of the airplane for travel. Already the airplane is an accepted mode of travel for selling petroleum products. Equipment manufacturers are using the airplane.

This use of the airplane is of double value. First it permits of quicker travel, saving time. Of perhaps greater value is the advertising it gives to aviation. Use of the airplane will grow in proportion to how much it is used. Each oil concern adopting the airplane is thereby convincing other concerns of its practical value. What the oil industry does in turn will convince other industries.

Grady Gilbert

"Spot Market Is Best for Both Buyer and Seller"

WHY GASOLINE AT POSTED

An Interview with L. A. SNYDER

By GRADY

BECAUSE sales policies and methods of the Champlin Refining Company, Enid, Oklahoma, bear directly uppermost with Mid-Continent refiners, this interview with Mr. L. A. Snyder, sales manager of that concern, is offered.

The vital problem with refiners generally and those of the Mid-Continent area in particular is that of selling gasoline at a profit. What the Champlin concern does on that score is of interest.

A point where the Champlin sales method is of interest to other refiners is that of posted prices. Posted prices for gasoline have had informal consideration and discussion for two years. This method came in for formal consideration at the meeting of the Western Petroleum Refiners' Association in Kansas City, March 6. This resulted in the naming of a committee, whose members are now studying the feasibility of selling gasoline at posted figures.

Many refiners have frankly admitted the desirability of posting gasoline prices and have signified willingness to try the method. Others say they would be glad to have the benefits of posted prices, but do not consider the proposal workable.

The sales methods of the Champlin Refining Company bear directly on the posted price proposal, since all its products are sold at figures which are public. There is no variation from the printed price list.

Prices Posted

CHAMPLIN prices are posted as crude oil prices are. Letters are printed, as reproduced herewith. These are sent to customers, to prospective customers and to other refining concerns. Until prices are changed at headquarters, prices fixed in those letters stand.

These letters and a force of twelve salesmen are the only medium by which Champlin prices are carried to customers. Behind these methods and policies, there is reasoning, which can best be expressed by Mr. Snyder:

"What refiners seem to need is a standard for determining prices. Two factors are essential to a just price of any product. All costs of manufacture should be calculated. To the total of these adequate profit should be added. These should be the price of gasoline for each refiner.

"Along with these, refiners should confine output to what the market will absorb normally. It is foolish to expect prices to stand, when finished products are far in excess of demand.

"Too much attention seems to be given to production and plant output. Production is preferable to profit. Capacity runs and filled storage place the refiner at the mercy of the buyer. Instead of offering certain products at certain prices, the refiner seeks sales to relieve his storage."

Mr. Snyder believes that regulated plant output would have an immediate and beneficial effect on oil production. On this he said:

"Any refiner can determine approximately what amount of finished products he can sell in a year. If each one would make purchases of crude oil according to such caiculations and then not buy and run raw material because it is cheap, drilling would be halted much more promptly than it is in times of over-supply of crude.

Would Control Prices

"BUT the chief benefit to refiners would be in preventing sudden and abrupt fluctuations in gasoline prices. Let refiners decide on output, calculate costs and add profit and their action would stabilize the market promptly. Then by holding to that plan of plant operation and that method of selling, there would be such scant differences in prices as fixed by each refiner that gasoline quotations would move in narrow limits of fluctuation.

"This is no effort to say that gasoline prices should not change. Seasons, weather and other factors warrant changes. But such changes should be made with cost and profit as the foundation."

He is convinced also that stable prices would prove of benefit to

Another Suggestion for Stabilizing Markets

SHOULD BE SOLD PRICES

Sales Manager, Champlin Refining Company

TRIPLETT

the jobber. He explained this, saying:

"The common method of selling gasoline today is for the refinery sales manager to broadcast by letters, wires and telephones the fact that he has an excess of finished product.

"These sales efforts are frequently accompanied by quotations. But jobbers do not interpret such efforts as meaning that these prices are fixed, or even expected. Both reasoning and experience warrant the jobber in believing that an offer at still a lower figure will result in a sale.

Jobber Becomes Speculator

"ACCORDINGLY the jobber becomes a speculator. If he can beat the price down, he is tempted to buy in excess of his needs. He will buy and hold gasoline, which he does not need. With this gasoline out of tanks, the refiner again fills his tanks. All this speculation is at the expense of the jobber. It has been done and he has paid for it by selling at no profit. Frequently sales are made at prices even below manufacturing cost, just to relieve storage.

"What the refiner does not seem to realize is that he could more quickly relieve his crowded storage by reducing runs in his plant. Furthermore, reduced runs would not place additional gasoline in the hands of jobbers, who can not be blamed for taking advantage of what promises to be a profitable purchase.

"In the steel industry, you never hear of stocks of pig iron determining the price of a single order of beams. The buyer of steel for a building seldom knows how much ore is above ground, how much pig iron is available or what the output of the steel mill is. Steel comes to the buyer with a price tag on it.

"Steel and gasoline are not comparable products, as to physical qualities. But selling is based on fundamentals and gasoline can be sold at a price, just as steel and many other products are sold.

"One price selling has been found so beneficial to other industries that the refining industry deserves criticism for not adopting it. Railway transportation, through rebates, was once a commodity of many prices. Conditions became so unsatisfactory that rates are now fixed.

Spot Market Best

"NOW when a man desires to ship his wares, he selects his routing. He knows the cost. Just as a shipper selects his routing, a gasoline buyer should select his product, knowing that the price quoted him is just what other buyers will pay for that product at that date.

"Wearing apparel was once sold by bargaining. The buyer of a suit of clothes was not satisfied until he had brought the price down. Now the leading clothing stores mark each suit of clothes in plain figures. These figures apply to all buyers.

"One price breeds confidence. The jobber, who beats a price down on one purchase, is justified in assuming that he can do that the next time he buys. He is justified, when he beats a price down with one refiner, in assuming that he can use similar tactics on other refiners."

While the Champlin Refining Company does sell on contract, Mr. Snyder favors a spot market. The contract this concern offers is in reality an assurance of supply. Its terms protect a buyer to within three and one-half cents of the prevailing tank wagon market. Local prices, the results of local price wars, are not supported by this company.

"But the spot market," he continued, "is best for both the seller and the buyer. For the seller it permits the changing of quotations as seasons and weather warrant. The buyer is benefited equally in that he gets the benefit of lower prices, which will come as often as higher prices."

Program of Natural Gasoline Association of America

TULSA.—The annual meeting of the Natural Gasoline Association of America will be confined to two days of formal program, with a third day for a field trip to the Greater Seminole area. To complete the program, it will be necessary to have one evening session, the first day.

The program will consist of papers and discussions of problems of both plan operation and economics of the industry.

The program follows:

MAY 22

Morning session—F. L. Chase, vice-president, Lone Star Gas Company, presiding.

Address of welcome—F. L. Chase.

President's annual address—H. A. Trower, sales manager, Phillips Petroleum Company.

Annual report of secretary-treasurer—A. V. Bourque, secretary of the Natural Gasoline Association of America.

Paper—Theory and Practice of Automatic Control—T. G. Laney, Fisher Governor Company.

Discussion, led by W. A. Melton, Shaffer Oil and Refining Company.

Afternoon session—E. L. Peck, general manager Empire Gasoline Company, presiding.

Paper—Theory and Practice of Rectification in Natural Gasoline Plants—L. S. Gregory, consulting engineer, Tulsa.

Discussion, led by G. G. Oberfel, director of research, Phillips Petroleum Company.

Paper—Some Considerations Affecting the Butane Supply—S. C. Carney, research engineer, Roxana Petroleum Corporation.

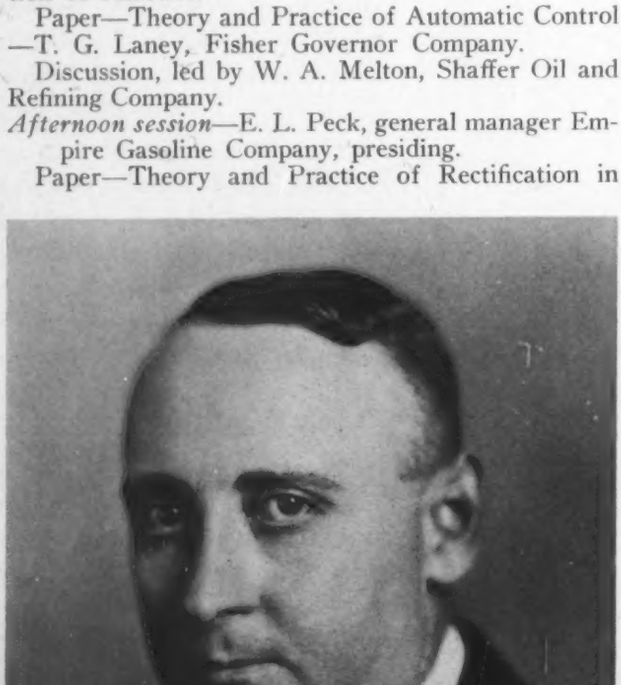
Discussion from the floor.

Paper—Second Progress Report of the Research Department—Dr. G. G. Brown, research director for the association.

Evening—George L. Ratcliffe, general manager gasoline division of the General Petroleum Corporation, Los Angeles, presiding.

Continuation of Second Progress Report—Dr. G. G. Brown.

Discussion from the floor.



H. A. TROWER
President, Natural Gasoline Association of America

MAY 23

Morning—Emby Kaye, Superintendent Natural Gasoline Division, Skelly Oil Company, presiding.

Paper—The Gas Lift and Repressuring and their Relation to the Natural Gasoline Industry—H. B. Bernard, vice-president, Sinclair Oil & Gas Company.

Discussion, led by G. M. Davidson, general superintendent Empire Gasoline Company.

Afternoon—Dr. E. R. Lederer, vice-president Texas Pacific Coal & Oil Company, presiding.

Paper—Methods in Marketing—W. T. Anderson, associate editor, the Oil & Gas Journal.

Discussion, led by D. E. Buchanan, vice-president, Chestnut & Smith Corporation.

Paper—Importance of Gas and Gasoline Analysis to the Natural Gasoline Industry—W. W. Robinson, Jr., California Gasoline Company, Los Angeles.

Discussion, led by George P. Bunn, assistant superintendent Phillips Petroleum Company.

Evening—Smoker and entertainment, provided by the Natural Gasoline Supply Men's Association.

MAY 24

Field trip to the Greater Seminole area.

This meeting will give the Natural Gasoline Supply Men's Association its first opportunity to function, as a permanent auxiliary to the Natural Gasoline Association of America. Last year the manufacturers supplying equipment for the natural gasoline industry formed an organization to furnish entertainment for the convention.

Preparations for the permanent organization were made then. Early this year steps were taken to perfect this organization. Indications at this time are that this body will have more than 50 members. Membership in the Natural Gasoline Supply Men's Association will supplant associate membership in the natural gasoline association.

The chief part to be played this year by the supply organization will be the stag smoker and entertainment the second evening of the convention. The smoker will supplant the annual banquet, which has been part of each convention.

Fundamentals of Natural Gasoline Plant Design

By W. F. FULTON
Chemical Engineer, The Palmer Corporation

TO select a definite point of view and stick to it is the first necessity of every designer. At first thought it might appear that the design of natural gasoline plants is complicated due to the difference of each process and the special equipment attached to each step in manufacture; however, this is not true, and on closer analysis of the field it will be apparent that the plant that is unique is rare indeed and that most plants are fundamentally the same in principle.

The underlying factor of all plants is the exchange of energy from one mass to another, and the handling of materials in the different states. The laws covering these operations are constant for all conditions regardless of the kind of natural gasoline plant. This function is to control and measure such changes and cause them to occur at the proper time and place in the process.

In order for the designer to know and select his point of view, he must be well versed in and study the general aspects of the field in which his design is expected to function. It can not be planned too carefully, the success or failure of the design depends upon the designer's ability to forsee the unknown conditions which might arise. The unknown conditions and properties of materials are very few and it is necessary for the successful designer to foresee each detail of the plant and plan to meet all conditions which might come up.

Profit Paramount

It is a failure when a design requires a large amount of capital to turn over and over without a return to the investors. It will be a "white elephant" for the capital invested.

The general considerations for all designers to take, before designing a natural gasoline plant are as follows:

1. The nature of the investment.
2. The nature of the industry.
3. The kind of plant and the process to be used.
4. The location, geographic, topographic, economic.

Then when the designer has secured all the information possible under these four heads, and has thoroughly digested them and thought out each point, he will have a mental picture of his object and his ability to understand and see the thing as a whole will show his ability as a designer.

After the designer has collected all the known data necessary it is for him to take each phase in detail.

He should make an outline of each phase and then work on one at a time considering every detail under each heading; the following is a good type of outline:

Relation of units.

1. Control of units.
   - A. Administrative.
   - B. Labor.
   - C. Time and labor and materials.
   - D. Weather conditions.
   - E. Safety, light, health.
2. Power distributions.
3. Waste disposal and sanitation.
4. Hazards and insurance.
5. Storage.

Study of Investment

The designer should know the nature of the investment. No plant is designed to lose money and the designer should keep in mind that the plant he is designing must make money in order to be a success. A satisfactory return on the investment is the purpose of the enterprise. The making of the product is secondary; making money is necessary for the plant to operate.

The designer must be an economist and design his plant according to the investment. He should know all the details connected with the investment, so he can consider interest on the investment. The time in which the investment must be returned, the rate of interest, depreciation of equipment and the amortization period will govern the construction and materials used.

If he finds, after figuring all these factors, they will not meet the conditions, he knows the design is impossible, and the wise engineer will see that it is not practical to build a plant under these conditions.

All operations have a minimum and a maximum scale on which they can be operated. These should be determined by the designer first and all subsequent decisions should be based on these scales of operation.

Nature of Design

After the nature of the investment, the next step is the nature of the design itself. By this is meant the general type of plant, or industry in which the plant will function. Whether it is based on accepted standard practice, established processes, or whether it is a new and untried process, where the unexpected might happen. New field designs of untried processes require more careful attention than those designed on old and proven principles of operation.

Regardless of the nature of the product a design to function in private service must consider permanancy of the plant. Whether large or small, both geographic and topographic location must be given consideration, and usually are determined on the designer's experience. In the case of small plants the designer is free to base all of his selections of location and other details on experience, but in larger plants he must secure added information, and be sure of all conditions, all types of construction and arrangement of processes.

Failure in some instances comes when the designer does not study the field and profit by the mistakes of others. He should learn experiences of other plants, their causes for failure and success. In this way costly errors can be avoided at the start. It is foolish for a designer to try to make a process function successfully when others have proven it a failure. Plants of similar nature should be inspected as they may divulge information that will save thousands of dollars.

In a new field and on the design of a type of plant, the designer is thrown on his own resources. He must take the responsibility, for there is no excuse for failure due to ignorance of the characteristics of materials themselves, or the use of principles and processes which have proven a failure in past experience.

In many cases a little preliminary research into the fundamental rules and laws of the plant will avoid unnecessary expense and costly after results.

Modern natural gasoline plant equipment has been standardized to the extent that a complete knowledge of the chemical and physical properties of the materials treated are easy to obtain, and the designer can select the process that will best enable him to meet conditions.

Failure is due to the designer not knowing in what way a material will act under certain conditions, although the behavior can be predicted in nine cases out of ten.

Type of Process

When the design of a plant is new or based on new conditions, all the properties both chemical and physical of all the materials handled should be ascertained before the plant is designed. It is absolutely necessary that this be done in order that the designer may know the kind of material to use and the sizes of various equipment for the plant. It is foolish to assume that because a certain material is like another material it will act the same way under the same conditions and can be handled as such. There are only five main types of processes, namely, transporting, energizing, reacting, separating and conditioning. Plant design deals with a correlation of these functions. The de-

signer should keep these in his mind and take each step in its order, and work it out in detail. Most plants can be separated into group processes as mentioned above. Production cost is the main feature in all cases when determining process and type of processes. The one that will function to the greatest economic advantage should be adopted. If the major process in the plant is transportation, this should be given most consideration. It must function to perfection if the rest of the plant is to run at ease and with freedom from shut downs. Cooperation of all units of the plant is necessary.

Location

There are three fundamentals of location—geographic, topographic and economic. On the location will depend the choice of material and construction type for protection from weather conditions such as rain, snow, heat, sunlight and wind.

In the erection of permanent plants concrete construction is best. In plants of short life, steel or wooden frame covered with black iron or galvanized iron is satisfactory. In damp climates walls will sweat and be damp all the time, if marked changes in weather conditions are present. The designer must allow for protection against all liquids, gases and materials in process and storage. They must be protected from weather. Safety conditions also must be considered. All buildings must be protected from settling, expansion and contraction due to weather changes. Piping must be protected from corrosion and weather.

Another factor of importance is the nature of the water present for use in the plant. If it is bad, it will cause a great deal of trouble in all processes. All concrete construction must have expansion joints filled with asphalt, or other suitable material.

The humidity of the atmosphere will effect the operation of internal combustion engines, cooling systems and other processes where it is necessary to control same. This is an important factor in some cases, and should be remembered by the designer.

Economic Considerations

The most important factor in economic location of plant is transportation. Transportation is esesntial to movement of raw materials and shipment of finished products. In the case of plants operating on gases it is necessary for the plant to be located near the gas carrying line. Rail facilities are important to provide shipment of the finished products so they can be handled without expenses being too large.

The next important economic factor is labor. The plant must be located so that labor is easy to get. The laborer must have good living conditions in order to be satisfied with his work.

The water supply must be available without excess expense.

Another factor in location of plant is the destination of the finished product, involving to what localities it is shipped, what freight rates will be charged, what distance it will be hauled, return of containers, handling charges, etc.

Topographic location is important, as the drainage disposal of waste products, movement of liquids depends on this factor of location. The location should be such as to allow good drainage, as the removal of all excess and waste products from plant location removes a hazard of fire, disease and accident.

It should allow the placing of the equipment and structures so they would be in safe location in regard to fire and accident.

Type of Construction

Most construction is of the following type:

Wooden frame covered with iron.
Steel frame covered with iron.
Wooden walls with metal roof.
Masonry walls with metal roof.
Concrete walls with metal roof.

The ideal condition to attain is the flow of liquids and gases from process to process without interruption. All units should be placed near each other in order to allow freedom of flow of material without excess friction, transportation connections and delays of movement of material. The less distance the material has to travel in being processed, the less the unit cost for handling.

Control

The plant should be controlled in the simplest and most economical manner. As to process it should be controlled by automatic devices wherever possible in order to remove the burden from the operator. All control equipment must be easy to reach and operate. Certain control equipment should be installed to be a protection in case of fire or accident. Control dials and instruments should be located in a place that can easily be seen by the operator, and also some control equipment should be placed in the manager's office.

Each process should be controlled as a unit, by special temperature devices, pressure regulators, velocity meters and other forms of control.

Safety valves should be placed on all pressure equipment, and the power plant. The boiler should be equipped with water alarms and level controls.

Power Distribution

In most cases it is cheaper to transmit power than it is to transmit materials. The efficient distribution of power is necessary in order to keep down excessive operating cost. The distribution is governed by the type of processes used. Most power systems are elastic and can be changed to suit the changes which arise in the plant. In all cases it should be figured out by the most practical, economic and expedient plan possible.

The cost of power is controlled by the fuel used in its generation. The handling of the fuel will be a factor in the power distribution system also the length of line to carry the power from process to process, and the distance from the prime movers to the machinery, location of machinery in regard to the rest of the equipment.

The power plant should be built large enough to allow for expansion without excessive cost of additions.

All waste from the plant should be handled so that no pollution of streams, damage to health or crops would be caused by its disposal. In many cases it is a fire hazard not only to the plant itself, but to other property in the neighborhood of the plant. Often costly law suits and property damage costs are paid because of lack of waste disposal.

Insurance and Safety

All of the property should be protected by fences, proper fire protection, accident protection and all requirements of insurance policy should be maintained at all times.

The designer should remember that all charges from the first payment on the property are charged against his estimate and the economy of his design should aid construction cost and time as well as operation, economy and cost.

The transportation of the material, equipment and erecting in place should be figured to save construction, time and money.

As all costs are a reflection on the designer, he is responsible for the success or failure of the investment from an operating standpoint.

NEW PLANT AT COTTON VALLEY

Shreveport, Louisiana. — Ohio Oil Company has under construction in the Cotton Valley Field, a new absorption gasoline plant. Capacity of the plant is rated at 85,000 gallons, and will process over 50,000,000 cubic feet of gas daily. The plant is Newton equipment throughout, and A. F. Clark, natural gasoline engineer for Hurley Brothers, Mid-Continent representatives for Newton equipment, has charge of the engineering on the new installation. This plant is styled as a high pressure installation, and is to operate under 400 pounds pressure.

MOVE PLANT TO DALLAS

Dallas.—A 2000-barrel capacity refinery will be erected by Everybody's Oil & Gas Company one-half mile from Eagle Ford, near here. The equipment from the plant of the National Petroleum Company at Greenville will be used in the Eagle Ford refinery. Everybody's company is retailing refined products in Dallas and the surrounding vicinity.

WEST TEXAS PLANT

Big Lake, Texas.—Plans have been announced for the construction here of a skimming plant, to be known probably as the Big Lake Refining Company. The initial capacity of the plant will be 1000 barrels a day. It is to be built by Roy McKee of Tulsa and E. B. McKee of San Angelo, Texas.

Natural Gas Used for Blending In North Texas

By RALPH GOODE

MUCH of the blending connected with the shipments of refined products is done at the loading rack. Especially is this true of gasoline as gravity is of prime importance in meeting specifications. The use of natural gasoline for blending has grown tremendously because high gravity coupled with low boiling constituents is of great value in adding to the fuel efficiency of motor gasoline.

In refining crude petroleum it is to the interest of the refiner that as large a yield as possible be realized from the crude charges without sacrificing quality in the recovery and hence the gravity of the recovered products are generally lower than that required in a marketable fuel and also the initial boiling point is usually higher than desirable. This requires a method of blending with fuels of higher gravity and lower boiling ranges and natural gasoline is the product found most useful in fulfilling the necessary requirements of bringing the gravity up, lowering the boiling range and adding to the efficiency of the finished product of the refinery.

The blending of light distillates with natural gasoline by means of compressed air is well known. The hydraulic or water pressure systems have also been used to some extent and possesses certain advantage. Air, however, is the more common in North Texas plants but it is being replaced by natural gas pressure from the industrial lines reaching the plants out of the Panhandle district.

By tying on to these lines at the plant the loading rack has practically an unlimited and continuous supply of pressure for unloading cars of natural gasoline.

Advantages of Gas

The use of gas instead of air has been found to effect economies in making the blends, reducing the loading losses in the tank car, saving time in loading and producing a thorough and efficient distribution of the natural gasoline throughout the product being blended.

The theory is advanced that the natural gas in passing through and carrying along the natural gasoline has a tendency to absorb some of the vapors and reaching a point of saturation drops out a percentage of the condensation in the tank car which in the case of air has a tendency to be blown over. It is well known that air, due to its nature, causes large loading losses to occur unless unusual precautions are taken. The saving in the loading time is considerable and appreciated by the loader. The pressure valve on the gas line is close at hand and may be opened or closed at will which is an advantage over air as generally this is controlled through a telephone arrangement.

In testing blends of more than "three ways" in the laboratory and where the blends were made consisting of high boiling naphthas and low boiling gasolines the samples showed a good uniform distillation and gravity range indicating that the belnd was thorough and efficient.

Where blending is done with natural gas the pressure line is laid from the main gas line to the loading rack and is of two-inch standard pipe. Hook-ups at the loading rack are provided to connect with the pressure system so that any number of cars of natural gasoline may be tied into or as fast as one is emptied without having to shunt a car. The lines are all under ground up to the risers leading to the tank cars. The natural gas pressure line is reduced from the two-inch to one-inch where it goes into the flexible hose leading to the dome head connections of the tank car. The flexible rubber or fiber hose has a connection at the pressure source, similar to the connection on a Westinghouse air hose which connects freight cars, which allows the connection to be broken in a second. The valve for feeding the gas pressure is just above the ground leading to the hose by means of inch connections. The outlet connections from the bottom of the tank car are reduced to three inches and the short lines lead into boxes of about two feet square set in the ground where the distributing line to the tank car for loading reaches.

Pressure Necessary

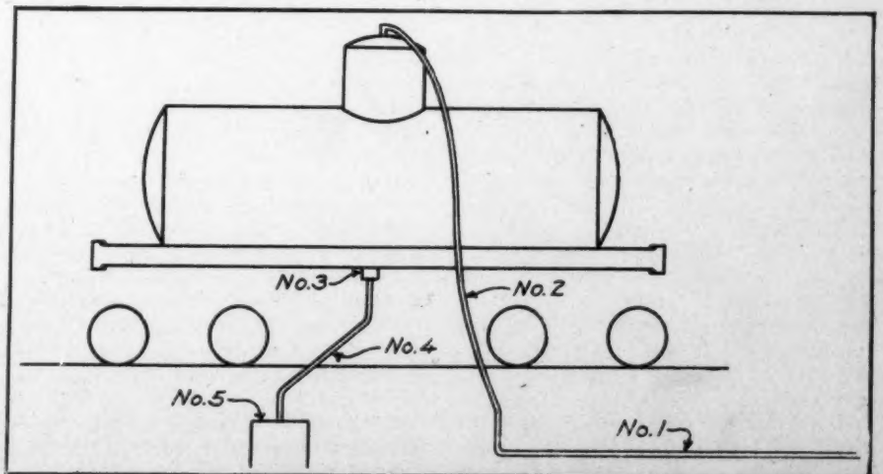
The pressure carried on the two-inch line from the main gas line is approximately 50 pounds although less than half this gas pressure is utilized in the blending operations. The pop valves on most of the tank cars in use by petroleum refiners are set for 25 pounds and this is usually true with the type of tank car used to handle natural gasoline. The loader using natural gas for pressure generally finds it necessary to crack the valve only slightly in order to have all the pressure needed to empty a carload of casinghead gasoline.

The cost of using natural gas for blending purposes is less than the cost of compressed air, especially in the North Texas field. Natural gas for industrial use in this area costs 11 cents a thousand cubic feet up to a certain amount and then it becomes less which leaves the cost of gas below 10 cents a thousand cubic feet where large amounts are used. A working pressure of 25 pounds of natural gas is sufficient for blending.

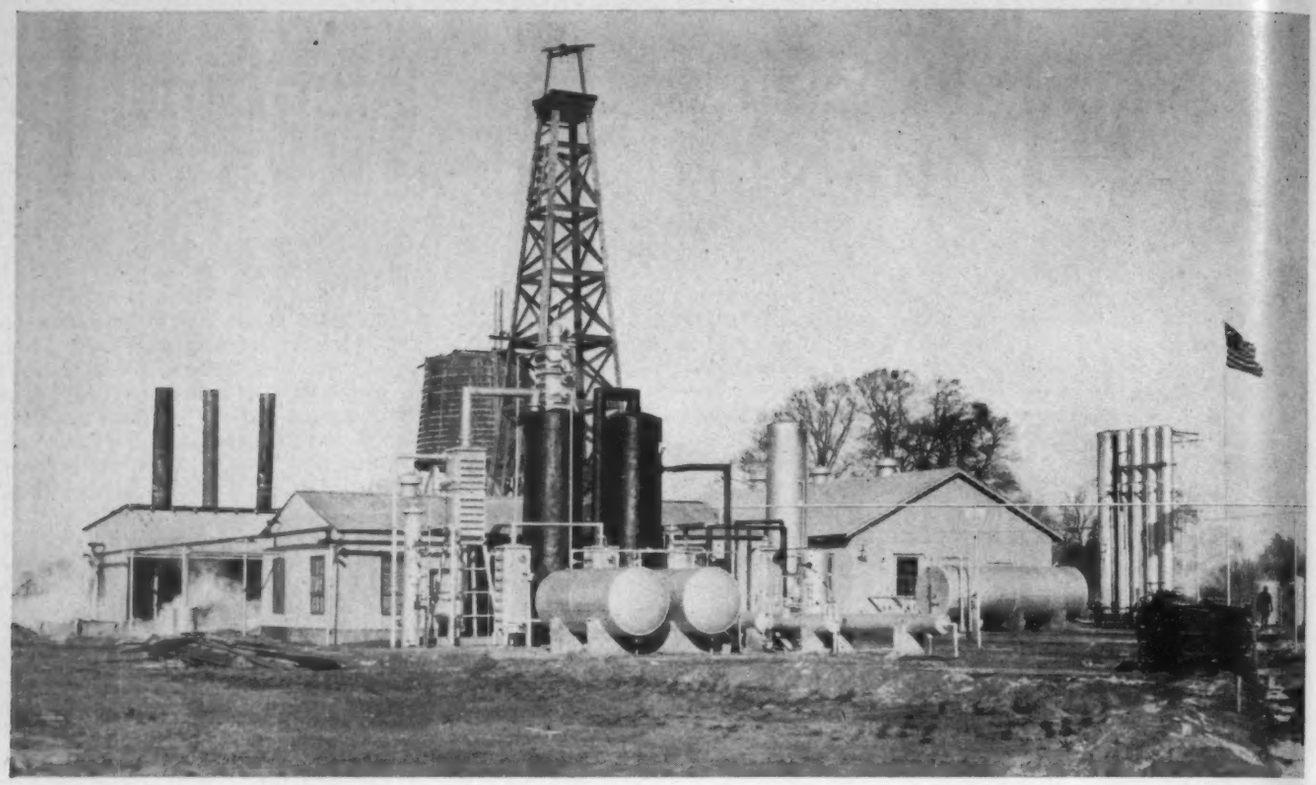
Taking the time element into consideration it usually requires 30 minutes to make a 12-inch natural gasoline blend in an eight thousand gallon tank car.

At a pressure of 25 pounds free gas pressure per minute it would cost approximately 37½ cents to blend the tank car by gas. Using air the figures would show that it would cost approximately 1.2 cents per minute or 36 cents to make the blend without taking into consideration depreciation of equipment and the time element required by the loader in having pumps started or shut down.

The plants that are at present utilizing natural gas for their pressure systems in North Texas find that there is a great deal more economy and satisfaction in using gas for pressure than was the case with compressed air. The possible hazard of explosion due to air and gasoline vapor mixtures occurring when air is used is virtually eliminated when natural gas is substituted in the manner discussed.



1—Two-inch line from gas main. 2—Flexible hose. 3—Outlet valve. 4—Three-inch line to receiving car. 5—Underground box.



Natural Gas and Fuel Corporation's 600 pound pressure absorption gasoline plant at Monroe, Louisiana.

Magenta Plant Operates Above 600 Pounds Pressure

By GEORGE REID
Associate Editor

THE absorption natural gasoline plant of the Natural Gas and Fuel Corporation at Magenta, near Monroe, Louisiana, operates at what is probably the highest operating pressure in this country. The absorber equipment is constructed to treat gas at a maximum pressure of 700 pounds per square inch. Ordinarily the pressure range is from 600 to 640 pounds, with an average over a recent month of 615 pounds.

Another unusual feature is the variable volume of gas throughput at this plant. Gas treated at this plant is derived from the company's own wells in the Richland Parish section of the Monroe gas field and is piped north to El Dorado, Camden, and other towns in Arkansas where it is consumed for domestic and industrial purposes. The number of wells producing and the volume of consumption at the distribution points governs the volume of gas which must pass through the absorbers at the plant. No compressors or booster station is necessary since the well pressure is so high, and as this pressure varies with the given well, the plant operating pressure likewise varies in accordance with the given wells producing into the pipe line. Several refineries in South Arkansas, as well as other industrial plants burn gas for fuel, and in the event of a shut down of any of these large users then the volume of gas passing through the line and the gasoline plant is materially affected. The pressure of gas entering the line is regulated at the well upon orders by company telephone from the distributing station perhaps 90 miles away.

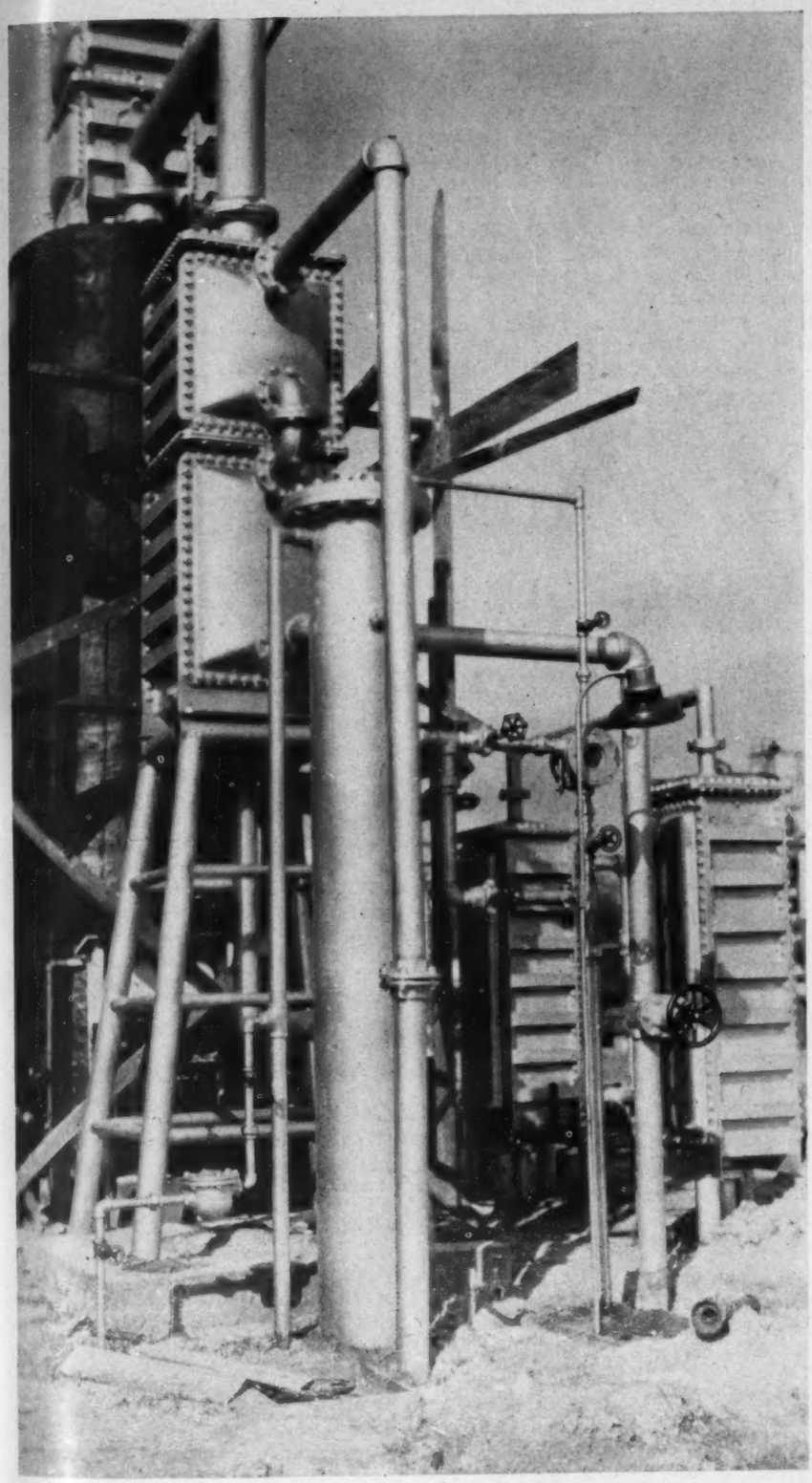
Weather conditions likewise influence the amount of gas consumed. Plant production of gasoline is governed by consumption of gas. Extraction of the gasoline at the Magenta plant serves to condition the gas for domestic and industrial consumption.

Standard charcoal tests of the gas being treated indicate a gasoline content of about 216 gallons per million cubic feet. Plant operation yields are somewhat higher than this average test, and during a recent month the average daily gas throughput of between 17,000,000 and 18,000,000 cubic feet yielded a daily average of 5187 gallons for that period. The best day of the month produced 6300 gallons. This gasoline meets either the specifications of grade C or BB. Normal production is 30 color, 86/90 gravity, 360 end point, with an 80 per cent recovery on distillation.

The plant was assembled from portions of two or three other plants moved in from other locations. The accompanying illustration shows something of the compactness of design. Five absorber towers are shown but only four of these are in service. The fifth absorber has been dismantled in preparation for the installation of a new bubble absorber of Southwestern type. The addition of this absorber is expected to effect an increase of plant throughput to around 22,000,000 cubic feet daily, and gasoline production to 6000 to 6300 gallons daily.

The four absorbers in operation at the time of the writer's visit were handling around 17,000,000 cubic feet of gas at 640 pounds pressure. The absorbers are Forest E. Gilmore, high pressure type. The four towers are but 24 inches in diameter and 40 feet in height. Despite the comparative small dimensions of the absorbers, each one is handling well over 4,000,000 cubic feet of gas daily with high efficiency.

Heat exchangers, oil coolers, distillation unit and reflux tower with vapor cooler section and condenser, are all Southwestern and of the standard type 75 unit. Two heat exchangers are used in which the oil from the the



Showing details of construction of home made gaso-water separating device placed between the condenser section and "look box."

absorbers enters at about 60 F. (winter weather) and leaves at about 180 degrees F. Hot oil enters the exchangers at 325 F. and is cooled down to about 160 F.

The preheated oil from the heat exchangers is conducted through live steam preheaters where it is further heated to 320 to 330 degrees F., at which temperature it enters the still. Distillation is effected with live steam at 20 to 25 pounds pressure. This pressure is held on the distillation unit, reflux tower, condensers and accumulator tanks. From the still the vapors are conducted to the bottom of the reflux column where they pass upward and into the control section at the top. This "knockout" box is cooled by water circulating countercurrent to the flow of the vapors. The temperature is constantly controlled by means of a Foxboro automatic temperature recorder controller, which regulates the flow of water through the cooling section by controlling the pump. Still temperature is indicated by a Bristol recording thermometer.

Handling Tail Gas

As an indication of plant efficiency under the high pressures prevailing, it may be stated that the saturation of rich oil is four per cent. This oil is stripped in the still to around one-tenth of one per cent. Oil is circulated through the plant at the rate of 50 gallons per minute. With plant production figures at 5800 gallons per day, this amounts to about 12½ gallons of absorption oil circulated per gallon of gasoline produced.

Oil and water are circulated through the system by belt driven machinery driven by one of two of the new type 45 horsepower Cooper engines, size 13x16 inches. Lean oil from oil cooler is transferred to absorbers by a Goulds single action, triplex, high pressure pump belt driven from the shaft which is belt driven by the type 16 Cooper engine. The rich oil from vent tank and tail gas absorber is circulated by a rotary pump. Cameron centrifugal pumps circulate water through knock out sections, etc. Water for plant needs is secured from an artesian well on the plant yard. The derrick shown in the illustration marks the central location of the source of water. The well is 468 feet deep.

No compressors are employed yet for the recompression of tail gases and the recovery of valuable gasoline in these vapors. The present arrangement is one of re-absorption of the tail gases, which has worked out very well. The vapors or tail gases are conducted from the accumulator tanks to the bottom of a small "tail gas absorber." A small rotary pump is used to circulate absorption oil from the vent tank to the tail gas absorber which passes down through the absorber, counterflow to the rising rich vapor from the accumulator tank. In this way the valuable gasoline content of the uncondensed gasoline vapors are absorbed and saved at a very slight cost for both equipment and operation, and plant efficiency is increased. The vapors or gases leaving the top of the tail gas absorber are then utilized as fuel under the plant boilers. No compressor is necessary in the operation of the tail gas absorber because the accumulator tanks are held at 20 pounds pressure and the re-absorption equipment operates under somewhat lower pressure.

Water Separator

Live steam used in the distillation equipment carries over with the gasoline vapors and is condensed to water in the condenser section. Unless this water is separated from the gasoline before it flows into the accumulator tanks, it must be drawn off the tanks and its presence there is conducive to rust and dirty tanks. To offset this and to secure automatic separation of water and gasoline a trap or gaso-

water separator of home made design has been installed between the condenser section and the look box. Details of construction of this device are shown in the accompanying photograph. The separator column is made of a piece of 12½ inch casing with flanged head on each end. The gasoline and condensed water leaving the condenser flows into the separator at about the middle of the trap. Upon separation the gasoline flows to the upper portion of the section of steel casing, and out through the line shown at the right of the trap and through the gas tight look box to storage tanks.

Condensed water settles to the bottom of the separator chamber and its level is controlled to the height at whichc the small trap, shown on the left, is placed. This trap is Johns-Mansville water trap, one inch size. A ball float inside of the trap is of such density that it floats in water and permits its flow outward and away from the trap. Since the ball will not float in gasoline, the trap immediately closes in the event any of the later fluid reaches it. Thus the gaso-water separator functions automatically and with no attention. The condensed water so reclaimed is conducted to the hot well for boiler use. The separator has the advantage of being economical of construction, as well as positive in its functioning.

No water cooling tower is in service at this plant since the cool water from the well is generous in its flow. The two Southwestern oil cooling sections provide the means for cooling the absorption oil to the desired operating temperature after it has been partially cooled in the exchangers. Taking into consideration the volume of gas treated and the production of gasoline through the four towers, the plant is very compact in its design and construction.

Prevention of Atmospheric Corrosion

By R. A. BOYD

Assistant Superintendent Columbian Gasoline Corporation

THIS is an article prepared for reading before one of the foremen's meetings of the Columbian Gasoline Corporation of Monroe, Louisiana. Mr. Boyd prepared a series of papers on the subject of corrosion.

Three of them have been selected for reproduction in THE REFINER AND NATURAL GASOLINE MANUFACTURER *and will appear in consecutive issues.*

Aside from the value of this paper as a guide in preventing corrosion, it is an excellent example of what can be done in an organization in the way of teaching employes. The Columbian Gasoline Corporation holds regular meetings of foremen and some subject is presented and discussed at each gathering.

SURROUNDING conditions affect atmospheric corrosion to a very great extent, also composition of metal, and the nature of the atmosphere. Therefore, there can be no general preventative for corrosion in the atmosphere.

In the atmosphere moisture is the controlling factor, as the gases that are found in air are much more active in moist than in dry air.

Corrosion will occur in air even when the moisture is not up to the saturation point. There is always an invisible film of water on the metal in the atmosphere which allows corrosion to proceed.

In some large manufacturing centers large amounts of solid matter are carried by the air and some of it is deposited on metal surfaces which accelerates corrosion by holding the moisture and by localizing corrosion.

It is claimed that purity has very little to do with corrosion in the atmosphere, but that steel with at least 0.15 per cent copper will increase the life of metal very materially.

Copper steel is especially beneficial when the metal is alternately wetted and dried and exposed to sunlight.

Some metals form a natural protective coating, such as zinc, aluminum, nickel and copper.

Copper base steel forms a very dense rust scale which retards corrosion and protects the metal to a great extent. It seems that if the rust is formed on copper steel in hot, dry weather, it is much more dense and protects the metal to a much greater extent than if formed under conditions where there is lots of moisture.

Protective Coatings

Artificial protective coatings are used to protect metal, this is usually some kind of a paint, either of a metallic or non-metallic nature and requires frequent renewal. There are different ways of preparing the metal before the coating is applied. Grease and oil can be removed with solvent naphtha. Mill scale and rust are removed by brushing, pickling and by sand blasting.

Acid pickling is done with a 5 to 10 per cent solution of sulphuric acid, or 5 per cent hydrochloric solution. This bath is usually kept at a temperature of about 180 F. The main objection to this method is that about 90 per cent of the scale and rust is removed in the first few minutes and then the acid attacks the bare metal while the remainder is being removed.

Another method is the electrolytic pickling which is accomplished by passing a current through an electrolytic solution and making the metal either the anode or cathode.

Sand blasting is effective in removing scale and rust and sometimes chilled shot are used. In cleaning a surface which has been painted, from five to seven pounds of sand are required per square foot to clean it satisfactorily.

Tests have been made with different pigments to determine their life, and it has been shown that red lead is one of the best metal protectives used. Red lead with a high litharge content should be better, as litharge is a very much better rust preventative than a neutral oxide. Red lead sets up a very durable elastic film which excludes moisture and gases. Also a red lead that is used for this purpose should be very finely ground.

Iron oxide paints are used very successfully as a protection to tin roofs, and general structural steel as priming coats as well as for surface coats on red lead.

Black oxide of iron is used as a priming coat on steel and gives very good service.

Chromate reds, American vermilion, showed in tests practically 100 per cent protection after four years service. This kind of paint does not weather as badly as red lead. However, this class of paint is very expensive and is only used in very small amounts or from 10 to 15 per cent in metal primers.

Paint Coatings

Black paints made from gas blacks, oil blacks, and graphite make a very tough surface paint when ground in linseed oil and are very good when used over a good priming coat such as red lead.

Very good results can be obtained by using gray paints with a blue lead base. This paint, however, has a tendency to fade unless carbon black or some other tinting matter is used. Also a certain amount of zinc oxide should be added to keep the paint from chalking.

Aluminum paint is made by stamping pure sheet aluminum into very thin flakes. These flakes are then polished. These flakes should be free from mica, which is used in some of the cheaper grades of paint. The vehicle of the aluminum part is usually spar varnish or heat treated lin-

seed oil. Before aluminum paint is applied to steel a priming coat of some base pigment should be used, utilizing the protective proportion of aluminum in the finishing coats. Bituminous paints made of asphalt and coal tar with a linseed oil vehicle and about 10 per cent Portland cement are very good as protection against chemical corrosion.

Due to the smooth surface of galvanized iron, paint will hardly adhere to it. However, after it has weathered a few months paint will stay on it, or new galvanized iron can be painted by first treating the surface with a solution of copper sulphate.

Tinned surface should first be rubbed with a cotton cloth saturated with benzine to remove the palm oil that is left on the surface of the tin during the tinning process, and then painted with an iron oxide paint containing an inhibitive pigment such as zinc, oxide, red lead, or zinc cromate.

Heat Resisting Paints

For high temperature, paints made up with a varnish vehicle are more durable than those with linseed oil. Varnish vehicle is also better in a very moist air and acid fumes.

There are several heat treatments for steel that give them different colors and form certain oxides that are a protection to a certain extent against corrosion.

Concrete, where it can be used, is a very good protection against corrosion in the atmosphere; this should be from 2 to 4 inches thick and not less than 1, 2, 4 mixture.

Slushing compounds are material similar to non-oxide, which is a nondrying compounds. It is used to protect metal surfaces which are at some future time to be cleaned. These mixtures are made of petroleum grease base, sometimes mixed or emulsified with about one-half of one per cent of bichromate. The above is very satsifactory where it is not exposed to direct action of the weather.

Mtallic Coatings

It has been found that ordinary axle grease is a good preservative of metal, when heated and applied to surfaces such as inside pipe work and structural steel parts of buildings.

Several different metallic coatings are used, such as lead, tin, zinc and copper. These are applied in different manners, as by hot dipping.

Electroplating is done with high amperage and low voltage in either a zinc cyanide or a zinc sulphate solution.

Zinc, copper, brass, aluminum and other metals are also sprayed on clean metal surfaces. This is accomplished with a special spray gun, using an acetylene flame and compressed air.

Copper and nickel plating are very good protections against corrosion when electroplated to iron or steel.

None of the above metallic coating processes is practical for field application.

It seems for atmospheric corrosion in ordinary atmosphere a priming coat of red lead, iron oxide, or chromate reds with a surface coating of black oxide of iron, aluminum, zinc, carbon or blue lead base paints as a surface, are the best protectives against corrosion in the atmosphere.

A Rapid Corrosion Test for Gasoline

By H. P. RUE
Associate Refinery Engineer, U. S. Bureau of Mines

FOR the proper control of gasoline treating plants there is need of a quick test for corrosion. In "sweetening" gasoline, that is, in treating it to remove evil smelling mercaptans or to convert them to disulphides or sulphides the sodium plumbite ("doctor") method is generally used. This method involves agitation of the gasoline with "doctor solution" (sodium plumbite made by dissolving litharge in a solution of caustic soda) in the presence of free sulphur[1]. One of the common mistakes in the technique of this process is the addition of too much free sulphur, which will dissolve in the gasoline and cause it to be corrosive. In the operation of a continuous sweetening or treating plant, a check on the corrosiveness of the product is imperative at all times. The copper-strip test commonly used in specifications takes so long to perform that the plant may fail to function properly for some time before the operator discovers it.

The writer has investigated a rapid corrosion test method involving the use of metallic mercury, recently developed by Messrs. G. T. Granger, refinery superintendent, and A. B. Comstock, chief chemist, of the Barnsdall Refineries, Inc., Okmulgee, Oklahoma. They have used this test successfully for several months in controlling the operation of their continuous treaters and have come to the conclusion that it has several advantages over the copper-strip test. Chief among these is the time saved, as the copper-strip test takes at least one-half hour, while the mercury test can be made in about five minutes. It is very evident that this is an important item in controlling a continuous treater.

Method

A 100-c.c. sample of the gasoline[2] drawn from the treater is placed in a clean four-ounce sample bottle and 1 c.c. of metallic mercury added. The bottle is shaken uniformly for two minutes, and the gasoline decanted off and filtered at once through an eight-inch qualitative filter paper. The filter paper is then dried by an electric fan or by natural operation.

The intensity of the black precipitate on the paper is a measure of the corrosiveness of the gasoline. A clean paper or one that is only slightly discolored indicates that the gasoline[3] will pass the copper-strip test. If there is a heavy black precipitate on the paper and the sample is negative to the doctor test it indicates that an excess of sulphur over that needed to complete the reaction has been added and that the gasoline will be corrosive.

The operator or chemist may have to compare the mercury and copper-strip tests of a few samples to interpret the former in terms of the latter, but after a little experience he should have no difficulty with this.

Five minutes usually is enough for completing the test. Thus the operator of the treating plant can know within five minutes from the time he starts his test whether or not he has added too much sulphur.

The mercury in this test can be used over and over again. When the mercury becomes dirty from particles of sulphides it may be cleaned by shaking with a few cubic centimeters of strong hydrochloric acid, washed with water, and dried on a filter paper, or it may be filtered through chamois. Tests can be made at regular intervals, and the filter sheets from the tests can be marked according to time and other data and posted on a board in the laboratory or at the treating plant; thus the chemist or operator can see at a glance how the treater is functioning and make changes to correspond.

The test seems to be more severe than the copper-strip test, as a perfectly clean paper is seldom obtained; but the range or graduations are much greater, which should allow much better control of the treating plant.

This test may also be used in testing the corrosion of gasolines that are too volatile to run by the copper-strip method.

This method is not unlike that worked out by Ormandy and Craven[4] for the quantitative determination of free sulphur. While the method as used by them gave good quantitative results, it takes too long for plant-control work.

Discussion

Tests have been made at various temperatures from 25 to 70 degrees F. to determine whether temperature had any effect upon the amount of precipitate deposited on the filter paper. The results of these determinations seem to indicate that temperature has little if any effect on the sensitiveness of the test, thus it can be made at any ordinary temperature.

A series of tests was made of samples of gasolines in which different amounts of free sulphur had been dissolved. The results show that the precipitate deposited on the filter paper is proportional to the

[1] Dow, D. B., The Treatment of Natural Gas Gasoline to Meet the Doctor Test, Repts of Investigations, Serial No. 2462, Bureau of Mines, April, 1923.

[2] Note: If this sample contains some suspended matter (known as hang-up) it should be filtered before the test is made.

[3] Note: If the doctor test of the sample before the corrosion test is made shaws that it is still sour, of course, it is evident that the treatment is not complete, and it will be necessary to make corresponding changes in the treater.

[4] Ormandy, W. R. and Craven, E. C., "Free sulphur in motor fuels." Jour. Inst. Petrol. Technol., vol. 9, No. 36, April, 1923, p. 133.

amount of sulphur dissolved. The increase in the amount of the precipitate formed is much more pronounced than the variations in the color of the copper-strip for the same test.

The test does not require use of any special apparatus, and its simplicity is such that the operator of the treating plant should have no difficulty in making the test and interpreting the results.

Some Effects of Free Sulphur and Sulphur Compounds in Gasoline.

Refiners all know that for the sodium plumbite reaction to be complete it is usually necessary to have free sulphur present. The following equations as established by Wendt and Diggs[5] will show why this is so.

$$2\,RSH + Na_2PbO_2 = \begin{matrix} RS \\ > \\ RS \end{matrix} Pb + NaOH$$

$$\begin{matrix} RS \\ > \\ RS \end{matrix} Pb + \text{Free Sulphur} = \begin{matrix} RS \\ | \\ RS \end{matrix} + PbS$$

If the exact amount of sulphur necessary to complete the reaction is added it is all taken up by the lead, but if an excess is added it will dissolve in the product under treatment, usually causing it to be corrosive to the copper-strip test. This, of course, depends on the temperature and length of time at which the test is made.

The corrosion (copper-strip) test of motor gasoline is usually made by submerging in it a strip of polished copper for three hours and holding the temperature at 122 degrees F. There are other variations of this, such as making the time one-half hour and temperature 200 degrees F., or time three hours and temperature 200 degrees F. The three hours at 200 degrees F. is the most rigid of the three. A comparison between these and different amounts of free sulphur is given in Table 1.

Based on gasoline with specific gravity of 0.754.

In interpreting the results of a corrosion test, more than extremely slight discoloration of the copper strip is called positive, but in the above table a distinction is made for the sake of comparison. It is evident from the above tests that the amount of free sulphur necessary to make a sample corrosive depends on the time and temperature at which the test is made. When the test was made three hours at 200 degrees F. on the sample used in these determinations apparently some of the sulphur compounds decomposed, as the sample showed positive even though no free sulphur had been added.

Certain sulphur compounds such as the mercaptans will give the gasoline an offensive odor and usually will cause it to go off color on standing[6]. The doctor test is ordinarily used to detect the presence of these mercaptans, although other sulphur compounds will react positive to the same test. The effect of a few sulphur compounds on the color of gasoline standing in storage, together with the doctor test, is shown in Table 2. In the tests shown a few drops (about 1/10 c. c.) of the pure surphur compound were added to each sample.

From the above table it is evident that the mercaptans give the greatest color drop in the sample of all the sulphur compounds tried. For this reason refiners try to treat them out or convert them to sulphides or disulphides.

TABLE 1
Corrosion and doctor tests of gasoline containing different amounts free sulphur

Sample	Free Sulphur per 1000 bbls., lbs.	%	Copper-strip test, 3 hrs. at 200 degrees F.	Copper-strip test, 1-2 hr. at 200 degrees F.	Copper-strip test, 3 hrs. at 122 degrees F.	Mercury test	Doctor test
1	0	0	Slight	Negative	Negative	Slight	Positive
2	5	.0018	do	do	do	do	do
3	10	.0026	do	do	do	do	do
4	15	.0055	do	do	do	do	do
5	20	.0073	do	do	do	do	do
6	25	.0091	Negative	do	do	do	Negative
7	30	.0109	Just noticeable	do	do	This and	do
8	35	.0127	do	do	do	following	do
9	40	.0146	do	Slight trace	do	samples	do
10	45	.0164	do	do	do	showed	do
11	50	.0182	Slight	do	do	very	do
12	55	.0200	do	do	do	black	do
13	60	.0218	do	do	do	precipitate	do
14	65	.0237	do	do	do	on filter	do
15	70	.0255	Positive	do	do	paper	do
16	75	.0273	do	do	do	do	do
17	80	.0291	do	do	do	do	do
18	85	.0309	do	Positive	do	do	do
19	90	.0328	do	do	Just noticeable	do	do
20	95	.0346	do	do	do	do	do
21	100	.0364	do	do	do	do	do

TABLE 2
Organic sulphur compounds in gasoline

Sulphur compound	Doctor test	Color of original sample	Color at end of 6 mos. after adding sulphur compound
Thiophenol	Positive	21	—16
Ally iso thiocyanate	do	21	— 2
Iso amyl mercaptan	do	21	Too yellow to take
N-Butyl Mercaptan	do	21	do
Ethyl disulphide	Negative	21	4
Ethyl sulphide	do	21	25
Iso amyl sulphide	do	21	25

Summary

A mercury corrosion test developed by the Barndall Refiners, Inc., at Okmulgee, Okla. is described. This test seems to offer possibilities, especially in the control of continuous sweetening plants using the sodium plumbite method of sweetening and in testing the corrosion of very volatile gasolines. It has been shown that when the copper strip test is run at 200 degrees F. for a period of three hours smaller percentages of free sulphur in gasoline can be detected than when the test is conducted at lower temperatures or for shorter periods of time. It has also been shown that the mercaptans produce more discoloration of gasoline in storage than the other pure sulphur compounds used in these tests. —Reports of Investigations, Bureau of Mines. Department of Commerce.

DOUBLING CAPACITY

New Orleans Refining Company, operating a 10,000-barrel plant at Norco, 30 miles north of New Orleans, is rushing to completion its new installation of skimming plant equipment, which will effect a doubling of crude capacity. The former units has been running 10,000 barrels of West Texas crude daily for some time, but will be put back into the production of asphalt from Mexican and Venezuelan crudes, for which it was primarily designed.

The new equipment is designed especially for the skimming of West Texas oils. Equipment consists of three large tubular retorts equipped with latest type bubble fractionating columns, and conjunctive auxiliary equipment.

CRACKING INSTALLATION

State Corporation Commissioner J. W. Friedlander has issued permit to the Process Construction Company, a California Corporation, to sell stock to finance the erection and operation of a cracking plant at Wilmington, California. The company is a subsidiary of the Western Oil & Refining Company, which has entered into contract to erect the cracking installation on the same site occupied by the parent company's skimming plant. Officers of the Process Construction Company are Richard Florian, L. J. Hart, A. A. G. Scherbel, A. W. Taylor and Arthur G. Baker.

[5]Wendt, G. L., and Diggs, S. H., "The chemistry of 'sweetening' in the petroleum industry." Ind. and Eng. Chem., vol. 16, No. 11, Nov., 1924, pp. 1113-1115.

[6]Dow, D. B., Work cited.

Wet Gas and Measurement Below Atmospheric Pressure

Read before Southwestern Gas Meter Course, University of Oklahoma, Norman, April 24, 1928, by R. D. Turner

IN the natural gas and natural gasoline industries of today, gas measurement plays an important part. Its importance to the Natural Gasoline Industry can well be realized when reminded of the fact, that in round numbers, one-third of the gasoline produced, or over one and a half million gallons per day having a value of over $78,000, even at present prices, is given in exchange for the casinghead gas. The cost of the gas is the largest single item of expense to a gasoline plant, and thousands of dollars may be lost annually through an indifferent attitude toward gas measurement. The importance of gas measurement is also reflected in the efficiency of plant operation. It is important that the plant operator know the quantity and richness of the gas he is handling in order that he may properly control the operation of his plant and obtain the highest degree of efficiency.

Since most casinghead and natural gas in the field is measured by orifice meter, the discussion in this paper refers largely to such measurement.

As casinghead gas, or "wet gas" as it is often termed, is in most cases handled under vacuum, one of the first and most difficult problems pertaining to plant operation and gas measurement is air infiltration. While this may be considered an operating problem, nevertheless, it devolves upon the meter men and gas measurement department to be constantly on the alert for air leaks, and make the proper adjustments in the meter readings. Air tests should be made at least once a day, and at plants where extremely high vacuum is required, such tests should be made more often. Aside from being dangerous to plant operation, air adds excess volume to the amount of gas purchased, overloads the machinery, and if not eliminated, consumes a great part, if not all, of the annual profits of a gasoline plant. Owing to the fact that the present type of gas meter will measure air in precisely the same manner as gas, the infiltration of air is difficult, and sometimes impossible, to detect, through the meter readings alone. However, if the chart changers are alert and on to their jobs, they can be of great assistance in the detection of air leaks, especially on settled leases, for they are familiar with the charts they are handling from day to day, and usually by observing the differential carefully, they can tell if the meter has registered a large or sudden influx of air, and any such irregularities should be immediately investigated and reported.

Casinghead Gas

As casinghead gas is the gas coming from the same sand or stratum as the oil, and since the marketing of such gas is usually subservient, or incidental, to the production of oil, many perplexing problems on this account confront the gasoline manufacturer. The success of the gasoline manufacturer depends a great deal on the co-operation given by the oil producer, the kind of tanks and equipment from which the gas may be taken, the care of oil and gas separators, etc. An arbitrary, or indifferent, attitude on the part of the oil operator, such as leaving the vacuum lines open to the air when cleaning out or running tubing, leaving gate valves and flow tanks open so that air will be carried in, cutting wells in and out without notifying the gasoline plant, will cause no end of grief to the gasoline manufacturer. Perhaps the greatest problem confronting the gasoline manufacturer, especially during the flush production stage, is getting the gas into the plant. This problem is greatly aggravated on account of the different methods which the oil producers use in the production of their oil. Some producers desire back pressure carried on their wells, while others want atmospheric pressure, or perhaps vacuum. Some of the gas is made available from pressure tanks or suitable gas traps, while in other cases the gas must be taken from flimsy paper shell tanks, all of which make difficult the regulation of the gathering system, metering, and the processing of the gas in the gasoline plant. During the period of flush production, the gas is usually taken from flow tanks or separators, and it is not an unusual occurrence, especially from wells that are flowing by heads, to get a slug of oil into the vacuum line, and hence, into the meter and connections, which usually necessitates a replacement of the mercury, and a general cleaning of the meter piping and fittings.

To overcome this difficulty, it has been necessary in some instances, to place a scrubber tank between the flow tank and meter, and install a small drip, filled with excelsior, on each side of the meter setting. It is also difficult to get an accurate measurement from a well that is flowing by heads. When the well is flowing, gas may be passing the orifice plate at the rate of several million feet per day, forcing the differential pen to the extreme edge of the chart, and when the well stops flowing, there is hardly enough gas to make a registration on the chart. Gas flowing under these conditions usually produces a chart of the "sunflower" type, which makes the calculations tedious.

After the period of flush production has passed, there usually comes a period of cleaning out and swabbing. Measuring gas from a swabbing well is perhaps the most difficult of all "wet gas" measurement, at least from a chart reading standpoint. When the swab is being pulled, a large volume of gas will be received, and when the swab is being lowered in the hole, a slight vacuum is created, which not only retards the flow of gas during this operation, but causes gas, quite often, to back flow through the meter. Like the well flowing by heads, it makes a very erratic chart, and if an accurate reading is desired, the chart should be read in 15-minute periods rather than hourly. A much nicer chart may be had by placing "dampeners" or "deadeners" in the meter, but this practice is usually unsatisfactory as it merely retards the flow of mercury from one chamber to the other, makes the meter sluggish and consequently inaccurate, and it is therefore a question whether the gas buyer or gas seller is getting the best of the deal. It is my opinion that a much more accurate reading will be had if the meter is left to record all flows of gas, and by reading the charts, if necessary, in 15-minute periods. However, in some instances, if a record of the flow is to be had at all, it is necessary to install "deadeners" in the meter.

As a general rule, and quite different from the general practice of dry gas measurement, one meter handles all the wells on each particular lease. The number of wells usually range from one to sixteen to a quarter section, and in some instances even a greater number. The writer is familiar with situations where as many as 23 wells feed through one meter on a quarter section. With a large number of wells feeding through a meter, it is quite probable that the flow of gas will be irregular, especially in new fields where considerable cleaning out, rod and tubing jobs, are necessary. This requires a frequent change of orifice plates, which in turn changes the value of the gas coefficient used in calculating the volumes. It is also often necessary in flush and semi-flush stages to make new gravity and gasoline content tests when wells are turned in and out, as the wells may vary considerably in richness.

Densities

Measurement of gas by means of an orifice meter requires an accurate determination of the density of the gas, and this is of particular importance in measuring casinghead gas, the densities of

Chemists Deal With Refining Problems

THE Petroleum Division of the American Chemical Society at its sessions during the national convention of the association, April 17-18, at St. Louis, Missouri, in its papers, brought out important discoveries of much interest in the matter of methods of treating gasolines, methods of analysis of gasolines to determine their aromatic and unsaturate content, the rate of transfer in heat exchangers, methods of displacing oil from producing sands by flooding, and the preparation of special liquid products by breaking down normally gaseous hydrocarbons. The last mentioned study is especially interesting to manufacturers of natural gasoline, since one of the major problems of the natural gasoline industry is the economic utilization of the lighter fractions of the natural gasoline which weather off in the stabilization processes. This is of interest also to refiners since such by-products may be produced from refinery tail gases and tank vapors.

Robert N. Pease's paper "Thermal Decomposition and Oxidation of the Simpler Hydrocarbons," outlined the conditions to dissociate the hydrocarbons found in the lighter fractions to make simpler gases which in turn may be used as fuel or a basis for chemical compounds. The following is an extract of this paper:

"Ethane, propane, n-butane and iso-butane are appreciably dissociated at 600 degrees-650 degrees C. in times of the order of one minute. The principal reactions are "dementhanation," dehydrogenation, and probably, for normal butane, "deethanation," giving rise to olefines. The reactions appear to be homogeneous, unimolecular gas reactions. The rates of dissociation increase as the molecule becomes larger. Normal butane and isobutane dissociate at nearly the same rate, but yield considerably different products, dehydrogenation accounting for about 50 per cent of the isobutane dissociated, and for only about 15 per cent of the normal butane. The results are consistent with the explanation that activation consists in a weakening of both carbon-carbon and carbon-hydrogen linkages, the ratio of products depending on the relative strengths of the two bonds.

"The reaction:

$$C_2H_6=C_2H_4+H_2$$

reversible in the region 550 degrees C.-650 degrees C. Equilibrium corresponds to 17 per cent dissociation at 600 degrees C. and 1 atm., and to 28 per cent dissociation at 650 degrees C. and 1 atm.

Ethylene and acetylene polymerize rather than dissociate in the 600-650 degrees C. range with heating times of a minute. A peculiarity of these reactions is that increased glass surface decreases the rate. This result is undoubtedly associated with the exothermic character of the reactions, similar results being obtained in hydrocarbon oxidation. The reactions are certainly not wall reactions. In particular, coating the wall with alumina or sodium hydroxide does not change the behavior of ethylene at 400 degrees C.

"The oxidation of the hydrocarbons above ethane is characterized by the fact that reaction may start abruptly as low as 300 degrees C., when the temperature is slowly raised, and nearly the whole of the oxygen is consumed. In the case of isobutane, which has chiefly been studied, reducing the heating time to a second the starting temperature is raised above 400 degrees C., and reaction does not go to completion. In either case a "hot spot" develops about a centimeter from the entrance. The gases were preheated. When the pressure is reduced to a few millimeters, there is no reaction in one minute below 600 degrees C. Assuming that the reaction is a homogeneous, bimolecular reaction with a heat activation of 50,000 cals., the pressure difference between the experiments at 400 degrees C. and 600 degrees C. accounts for the difference in reaction rate; that is, 400 degrees C. and 1 atm. is about equivalent to 600 degrees C. and 6.01 atm.

The products of oxidation at the lower temperatures are in part water, acids and aldehydes, and carbon monoxide, carbon dioxide, olefines and lower hydrocarbons. Usually more oxygen is consumed than hydrocarbon, but a complete checkup of entering and off-gas has not yet been made.

"An interesting feature of these oxidations is that increasing the amount of surface by introduction of broken glass decreases the amount of reaction. The function of the glass may be in part to assist in carrying the heat of reaction to the walls. More, especially, however, it is thought that the glass takes care of the energy of 'hot molecules' reducing these to the average and distributing the energy among many other molecules. The fact that increasing the surface slows the reaction is good evidence that the reaction takes place chiefly in the gas phase. Coating the surface with potassium chloride also decreases the rate, either by suppressing any wall reaction or by facilitating the loss of energy by 'hot molecules.'

"Similar results are obtained with methane at 600-700 degrees C. and with hydrogen at 550-650 degrees C."

A paper by Charles D. Hurd and LeRoy U. Spence described the decomposition of normal butane and iso-butane at high temperatures, forming aromatic hydrocarbons in important quantities. Their experiments indicated that "with a rate of flow which represents a hot-contact-time of about one minute (300-400 cubic centimeters per minute through a pyrex tube 30 inches by one inch) n-butane vapors are three-fourths decomposed by one passage at 700 degrees C., and are one-fifth pyrolized at 600 degrees C.

"Dehydrogenation reactions appear to the extent of 9 per cent in the former case, but are of slight magnitude in the latter. In both cases, the chief course of the reaction is one of scission into simpler paraffin and olefin hydrocarbons. Propylene is decidedly the dominant olefine at 600 degrees, whereas at 700 degrees the relative volumes of propylene and ethylene are nearly equal.

Iso-butane is about seven-tenths decomposed at 700 degrees, and one-fourth at 600 degrees; therefore, the extent of de composition of the two butanes at 600 degrees and 700 degrees is quite similar. Nearly half of the reaction of iso-butane at 600 degrees is a dehydrogenation reaction into hydrogen and iso-butylene, showing how fundamentally different is the course of pyrolysis of normal and iso-butane. The scission reaction of iso-butane into methane and popylene becomes more prominent at 700 degrees."

S. C. Lind and George Glocker, in their paper, "The Action of Electrical Discharge on Ethane," reported on a series of experiments involving the breaking down of hydrocarbon gases by the passage of electrical discharges through them. By effecting a discharge of 12,000 volts through the gases, various heavy hydrocarbon liquids were produced and some solid hydrocarbons. Experiments show that the lighter the hydrocarbon treated the greater was the quantity of liquid products obtained.

Stuart M. Roger and Linden R. Adkins presented a paper describing a new type of viscosimeter for petroleum products of the same general proportions of the Saybolt viscosimeter by requiring less than 10 cubic centimeter sample, and which can be used in conjunction with the standard instrument.

In addition several other papers dealing with various subjects of interest and importance to the refining and natural gasoline industry were presented, as follows:

S. H. Diggs and S. F. Campbell, Chem-

istry of Lead "Soaps" Made from Litharge and Natural Fat.

W. F. Faragher, J. C. Morrell and I. M. Levine. Determination of Olefins and Aromatic Hydrocarbons.

E. C. Alderman. An Analytical Method for the Separation of Bright Stocks and Neutral Oil Mixtures.

Stuart M. Rogers and Linden R. Adkins. A Micro-Saybolt Type Viscometer.

Hal B. Coats and George G. Brown, Jr. The Vapor Pressure of Hydrocarbons.

O. C. Bridgeman. Dew Points of Air-Gasoline Mixtures from Distillation Curves.

P. Borgstrom, L. M. Ellis, Jr., and E. Emmet Reid. Reaction of a Variety of Known Mercaptans in a Naphtha Solution with the Doctor Solution.

F. E. Bartell and F. L. Miller. Displacement of Petroleum Oil from Oil-Bearing Sands. 1—The Degree of Wetting of Silica by Crude Oils.

A. Skinner and G. G. Brown, Jr. True Volatility from the A.S.T.M. Distillation.

Robert A. Baxter. The Refining of Shale Gasoline.

Robert A. Baxter. The Effect of Variations in Retorting Conditions on the Quality of Oil Produced from Shales.

G. G. Brown, Jr. Anti-knock Testing.

J. C. Geniesse and H. F. Huf. Effect of Volatility of Petroleum Fractions on Detonation Value.

M. Garcia. Heat Transfer in Oils Flowing Through Pipes.

Automatic Control Equipment in the Modern Refinery

By C. B. FAUGHT AND F. R. STALEY
Texas Pacific Coal and Oil Company

BOILED down to bare facts, there are only three basic methods of controlling the operation of a piece of equipment.

Fundamentally these methods are:

1. Entirely manual.
2. Combination manual and automatic.
3. Entirely automatic.

Considering the many developments of recent years, a surprisingly large percentage of the total operations in a strictly modern refinery are still classed as manual. A steam pump, operating on full boiler line pressure, with steam admitted through either gate, globe or needle valve, without further attachments, is a good example of this. Each appreciable increase or decrease in the line pressure is reflected instantly in the speed of the pump. This in turn increases or decreases the volume of liquid handled by the pump.

Experiments on throughput of a four tower continuous gasoline treating plant revealed that a drop of five pounds of steam pressure lowered the throughput of the plant 12 barrels per hour falling from 105 to 100 pounds steam, 15 barrels from 100 to 95 pounds and 23 barrels per hour from 95 to 90 pounds.

The simplest method of converting the steam pump into a combination manual and automatic is to install a pressure regulating valve in the steam line between the boiler station and the pump. This effects an immediate change in the layout.

Steam Control Valves

Given a definite pressure in the steam end of the pump, the possibility of a definite quantity of oil passing through the liquid end is admitted. Set the pump on a definite stroke, with sufficient throttling sensitivity and very little variation will be noted in the hourly throughput, assuming that the temperature and viscosity of the liquid remains constant.

A large part of the trouble in maintaining volume throughput of still charging stock can be eliminated by the use of the proper type of steam control valve.

There are two principal types of steam control valves:

Direct control.

Pilot control.

In direct control operations, the down stream steam pressure is applied directly on the diaphragm of the main reducing valve.

The disadvantage of this type of control is that it is impossible to get close regulation unless the valve in the line is figured to a very close point of capacity and allowing for a very small range. The volume through the valve necessarily must not vary beyond very close limits.

On the other hand with pilot control, the down stream or reduced steam pressure is applied to a small pilot valve, approximately one-half inch in all cases, so as to allow over or under capacity. The auxiliary power or pressure used for operating the main reducing valve is brought direct from the line at approximately 25 pounds to the diaphragm of the main reducing valve. The pilot valve is placed as an offset in this auxiliary power line and relieves and applies the pressure from the auxiliary power line to the main reducing valve diaphragm in accordance with the changes in pressure on the down stream side of the main reducing valve. This gives an application of from 10 to 20 pounds pressure instantaneously on the slightest variation. Otherwise there would be applied only the variance in the pressure on the down stream side. The pilot control gives very quick action and resultant constant pressure and covers very wide fluctuations in steam consumed.

Constant Pressure

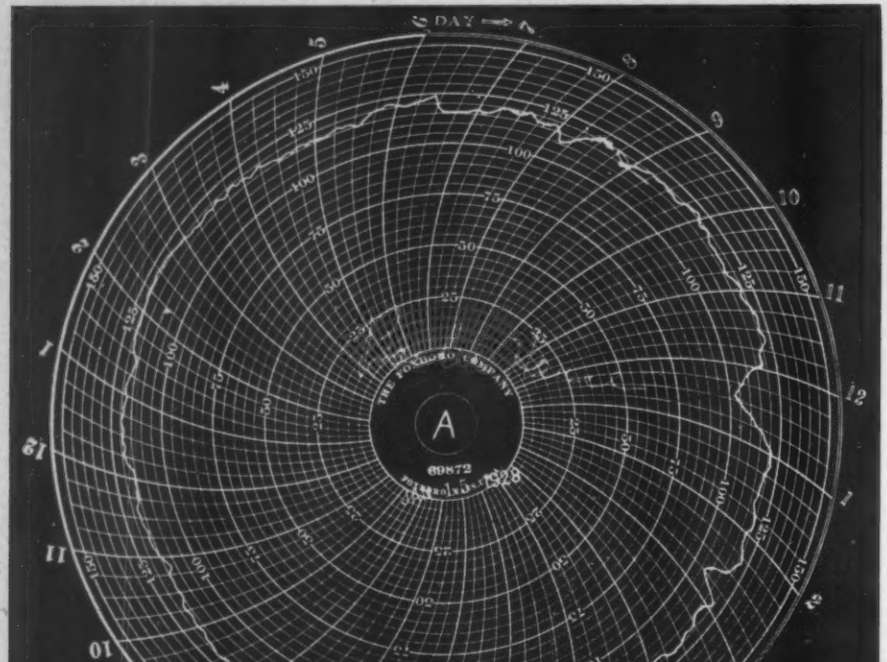
The chart "A" shows the steam pressure on the feed line from the boiler station. Chart "B" is the pressure on the down stream side of the line. This pilot valve continues to function so that when pressure on the up stream side falls, it maintains the pressure on the down stream until both are almost equal, usually within four or five pounds before an appreciable drop is noticed. Chart "A" at 12:25 p. m. recorded a drop in boiler pressure of approximately 20 pounds. Chart "B" records a drop of only two pounds, which was effective only when the two line pressures were very close together. Charts "C" and "D" are typical of a perfectly controlled operation.

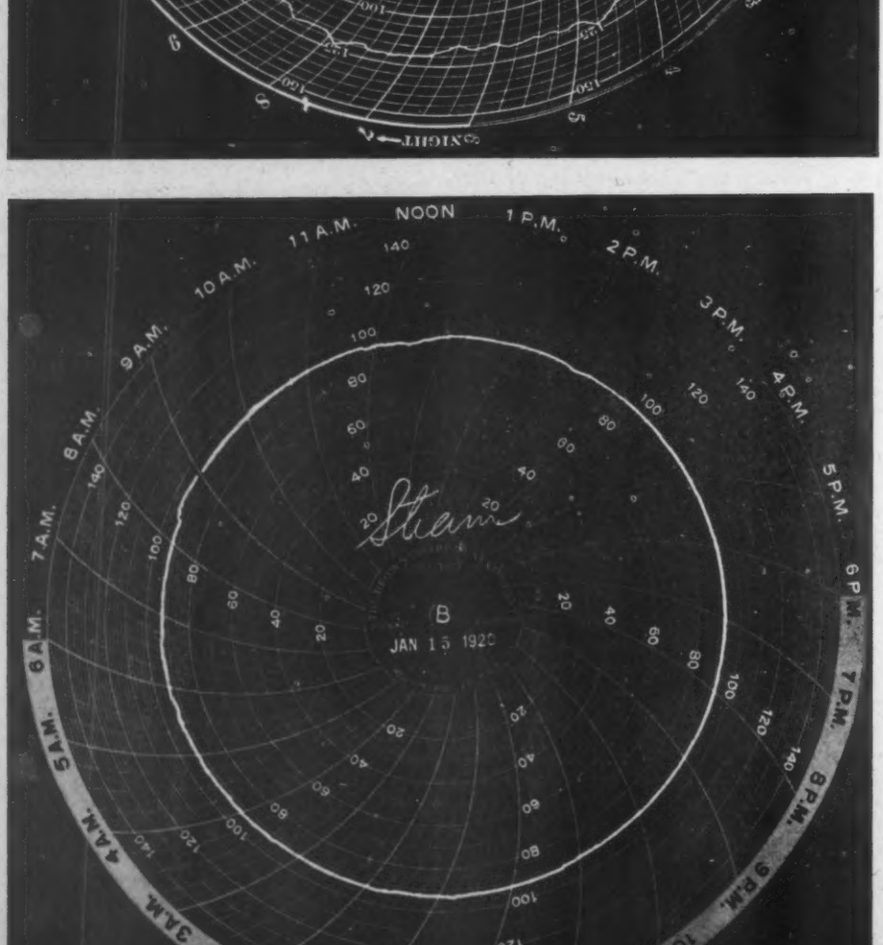
Too much significance can not be placed on the effect of constant steam pressure to a unit which must be operated at a predetermined capacity. Where this one factor is constant, such variables as temperature and pressure can also be maintained within very small limits with the minimum amount of attention. In fact, in certain units such as the Cross cracking still, the pilot type control valve on the steam line which feeds the high pressure hot oil pumps, has been found so effective that automatic burner control is not only unnecessary but would be entirely useless when the same type of pilot control valve is used to maintain a constant gas pressure on the burner line.

Another widely used installation is the automatic vapor temperature control of fractionating towers. The development of these instruments has made the successful operations of bubble towers possible. It is a physical impossibility to do by hand what these instruments do automatically. Close fractionation of gasoline, kerosene, ab-

sorption oil distillate and gas oil is necessary where maximum yields are wanted.

This close fractionation is only possible when done automatically because of the elimination of overlapping. So sensitive are the instruments that as soon as a change of conditions occur in the tower, it is instantly righted and adjusted. If this were being done by hand operated control, the operator would wait for the change to be recorded on the chart before he would make the adjustment to correct the condition. This interval of time is known as an "overlap" or "lag" and can not be "balanced" by running on the other side of the line.





Liquid Level Regulation

Consider that these changes are continually taking place in the tower. The operator would be opening and closing valves endlessly, and the charts would have a jagged appearance. The automatic control catches the change instantly and corrects the condition, and as a result the cuts are maintained at predetermined limits.

In connection with the automatic control of fractionating equipment, the liquid level regulator should receive serious consideration. There are several types available which may be divided into two classes, through continuous discharge and intermittent discharge.

It has been found that when operating cracking units where quantities of non-condensable gasses are produced, and where an efficient gas recovery system is in operation on the gasoline run down tanks, the evaporation loss an the run down tanks was cut 50 per cent by replacing an intermittent discharge valve on the gas separator with a valve that allowed the liquid to discharge continuously. In addition to the saving in evaporation, the strain exerted on the gas recovery system by the successive increase and decrease of vapors discharged into the recovery lines was eliminated and the air content of the recovered gases was reduced from 18 per cent to less than 1 per cent. It is an evident fact that when the gasses are allowed to collect in the separator during the time the liquid level is being built up, where the intermittent discharge valve is used, these gases are released with the gasoline, and the combined volume is released into the gasoline run down tank with such force that there is much turbulence in the liquid with the result that the vapor space above the liquid is filled and the gases compressed to a greater pressure than is usually carried on the gas conservation valves. As a result a quantity of the gases is blown into the air and is lost during this period of discharge. These tank gases are very rich with recoverable gasoline.

Vacuum Essential

To eliminate this condition, the use of the continuous type of liquid level regulating valve has been found very effective. When the liquid is allowed to flow steadily from the separator to the run down tanks, there is a minimum disturbance in the tank and consequently there are no flush periods. The entrained gases have an opportunity to release themselves from the body of the liquid and are carried off in the gas recovery system with no strain on the unit.

Extreme care must be exercised in maintaining a vacuum on the gas re-

covery unit. Tanks should not be subjected to more vacuum than is absolutely necessary to collect the gases. In most cases one-half inch of water is sufficient. This vacuum can be maintained most effectively by the use of back pressure vacuum regulating valves, installed as close to the tank as possible. Too high a vacuum will cause excessive tank losses due to reduction of the vapor pressure of the liquid. This permits more liquid to vaporize.

This type of valve is usually spring loaded or weight loaded. For very close control, the spring loaded valve gives better results. It is also less subjected to tampering with on the part of the operators. Where weights are used, there is too much of a tendency to change the weights when the valve does not apparently function properly, instead of making the change at the source of the pull.

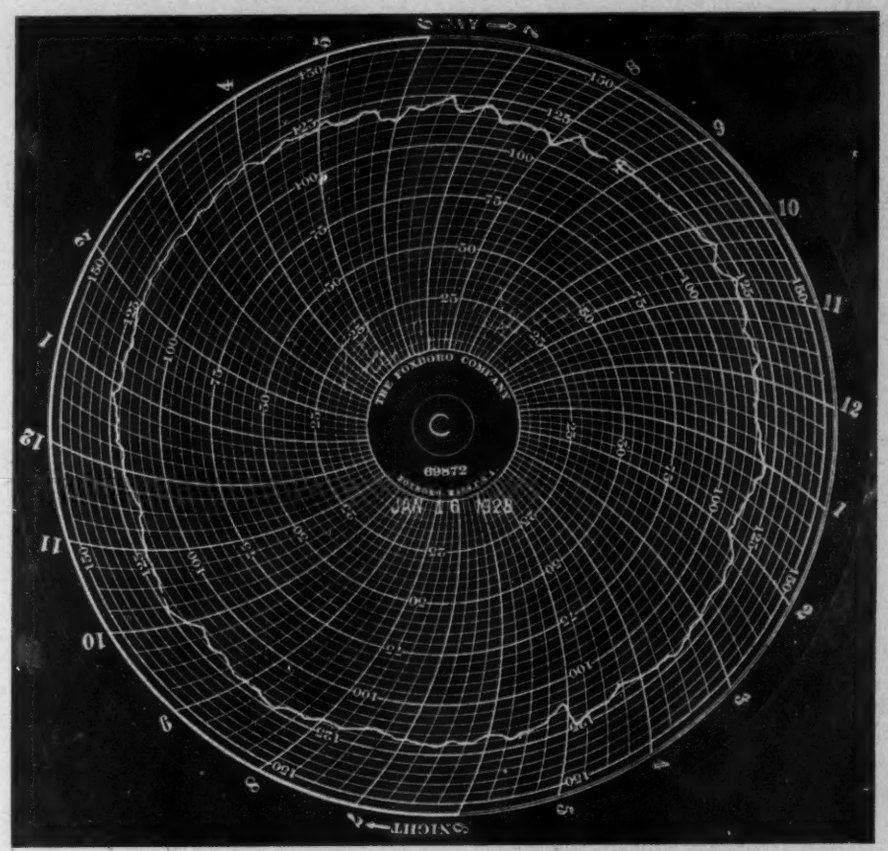
The size of the vacuum valve needed for a given volume of gases, through a line is easily determined. To this should be added the margin for peak loads during hot weather. With proper care, the automatic recovery system can be made to collect all the plant gases with an air content as low as one per cent. This is not unusual, but is necessary when maximum yields are demanded on the gas recovery unit.

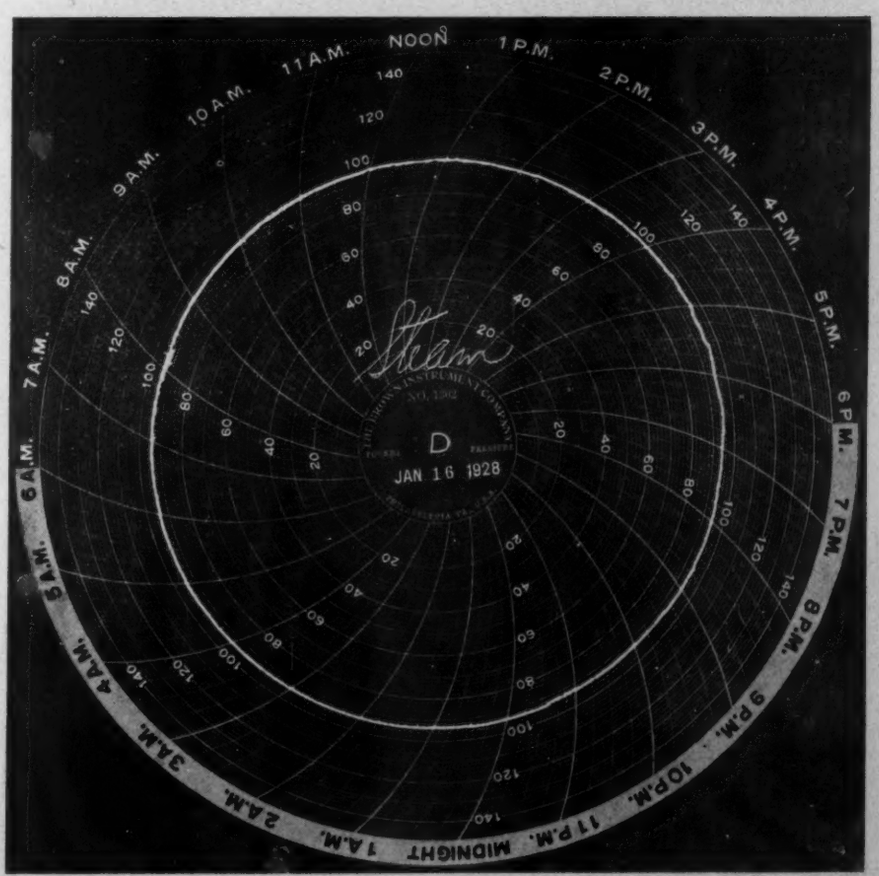
In summarizing the use of automatic controlled equipment in a modern refinery, it is gratifying to observe the efficiency of the equipment available. Even so, there are a surprisingly large number of operations which, as yet, have not been successfully handled through the use of automatic control equipment.

Concrete Booklet

After extensive study of actual conditions in many of the largest refineries and producing fields in the United States, the Portland Cement Association has published an interesting and valuable booklet, discussing and illustrating the many uses of Portland cement and concrete by the oil industry—in fields and refinery. Distribution of the booklet is free to all refiners, gasoline manufacturers and oil producers who will write for copies. The address of the Portland Cement Association is 33 West Grand Avenue, Chicago.

The booklet is divided into four parts, the third part being devoted entirely to the use of concrete in refineries. In this section it is pointed out that directly from the use of concrete as a building material come many desired features, including safety from fires and consequent low insurance; freedom from maintenance and depreciation; adaptability; permanence; and speed of construction, regardless of season. A detailed discussion is given of the general uses of concrete in the refineries, and under other headings there are discussions of various special uses for it, such as for electrical conduits, bases for railroad tracks, pipe trenches, separator boxes, sewers for refineries, loading racks, and recreational facilities. Suggested specifications for concrete to be used in refineries are given in the fourth part of the booklet, and in the same section appear specifications for concrete derrick foundations.





Refrigerating Engineering in Petroleum Refineries

By H. L. KAUFFMAN

REFRIGERATION is used in the refining of petroleum products in order to solidify and to separate the solid paraffin hydrocarbons contained in lubricating oils that are being made from paraffin or mixed-base crudes. These solid paraffin bodies are removed from overhead lubricating distillates by chilling such distillates to a temperature of about plus 20 degrees F., and thereafter separating the congealed wax from the oil by the use of suitable filter presses; while from residual oils, the wax is removed from the chilled naptha-solution of the oil either by cold-settling or centrifugal methods.

The present discussion will deal, for the most part, with the principles of refrigeration and how various engineering and operating problems encountered in the maintenance of refrigerating machines are solved.

As is well known, the theory of refrigeration is based upon the flow of heat from a warm body to one that is cooler. In petroleum refining, this problem usually involves the cooling of brine (as direct expansion is not often applicable in this industry) by some refrigerating means, and then having the heat from the warm petroleum oil transferred to the colder brine (calcium chloride) solution.

The heat-transfer efficiency between brine and oil is dependent largely upon the condition of the surfaces of the pipes through which the liquids are passed, as well as upon the velocity of flow of each. The accumulation of scale, dirt or wax on these surfaces will materially decrease the "transfer" efficiency, even when such accumulations are as thin as one-sixteenth of an inch, and will result in reduced capacity or, if not corrected, even the complete failure of the plant. For obtaining highest efficiency from any refrigerating machine used in the petroleum refining industry, where such refrigeration results in the congealing or precipitation of paraffin wax, **it is** ***therefore of the utmost importance that the heat transfer surfaces be kept in good condition by the prompt removal of those substances that tend to decrease the heat-transfer ratio.***

Types of Refrigerating Systems

The two general systems of refrigeration in use in petroleum refineries are (1) the "compression system" and (2) the "absorption system". Various refrigerating mediums, including ammonia, can be used in the compression system but the absorption system is designed for the use of ammonia alone.

In the ammonia compression system the ammonia gas enters the compressor at a low pressure, e. g., 15 pounds, where it is compressed to a relatively high pressure, e. g., 185 pounds, as a result of which the temperature of the gas also is raised. After passing through an oil separator to remove any oil "picked up" in the compressor, the compressed gas passes through a pipe condenser, over which water is sprayed, or a double-pipe condenser may be used in which case water is passed through the outer pipe. The cooling water liquefies the compressed gas, after which the liquid ammonia flows to a liquid "receiver." From this receiver the liquid ammonia is then released, through an expansion valve, into the expansion coils, as a result of which its pressure automatically drops from 185 pounds (condenser pressure) to 15 pounds, which latter, let us say, is the suction pressure maintained by the refrigerating machine with which the expansion coils are in direct contact. This reduction in pressure results in a drop in temperature from 95 degrees to 0 degrees F. The cold liquid in the expansion coils is now wholly unconfined: therefore, it boils away to a gas and while so doing absorbs heat from the brine solution with which it is in indirect contact.

If temperatures below 0 degrees F. are desired, two-stage compression must be adapted if it is desired to use the ammonia compression system.

Absorption System

The ammonia-absorption system is the system most frequently used in oil refineries. Its commercial success is based upon the great solubility of ammonia gas in water. The essential apparatus in use in this system is as follows:

1. Generator.
2. Absorber.
3. Condenser.
4. Brine cooler or expansion coils.
5 Weak-liquor cooler.
6. Rectifier.
7. Exchanger.
8. Pumps, connecting lines, etc.

In the operation of a refrigerating machine of this type, the generator is first filled with sufficient aqua ammonia to cover the steam coils and the absorber, also, with enough weak ammonia to submerge the water tubes. Next, the brine pump is started and brine is circulated through the cooling coils, after which water is turned into the machine. This water enters the bottom header of the condenser and, after passing through the condenser, enters the absorber. After circulating through the tubes of the absorber, in most refrigerating machines of this type, the water is usually divided—part going through the weak-liquid cooler and part through the rectifier. By this arrangement the original water supply is used progressively in four different pieces of apparatus, each at a somewhat higher temperature than the preceding.

The next operation is to admit steam slowly into the generator coils until the full exhaust-steam pressure has been reached. The steam heats the ammonia in the generator, thus rasing the pressure on the generator, condenser and rectifier until a point sufficiently high has been reached at which the ammonia gas in the condenser will be condensed.

As the gas passes through the rectifier on its way to the condenser, it is cooled sufficiently (by the water passing through the tubes) to result in the separation of any vapor that may have been contained in it. The dry or anhydrous gas passes to the condenser where it is condensed and then drains, in liquid form, into an anhydrous receiver. The liquid anhydrous ammonia is then fed through the expansion valve into the brine cooler, the same as in the compression system. The expansion valve is throttled so as to keep a constant liquid level in the anhydrous receiver.

Likewise, as in the compression system, the pressure in the brine cooler is much lower than that in the condenser. At this lower pressure the ammonia boils and absorbs heat from the brine circulating through the coils. This absorption of heat changes the ammonia from a liquid to a gas.

To recover this gas, weak ammonia liquor (from which the gas has been expelled by heat in the steam coils) is drawn from the bottom of the generator through the exchanger coils and thence through the weak-liquor cooler into the absorber. Owing to the great affinity of water for ammonia gas, this weak ammonia liquor absorbs the gas coming from the brine cooler and, consequently keeps the pressure in the

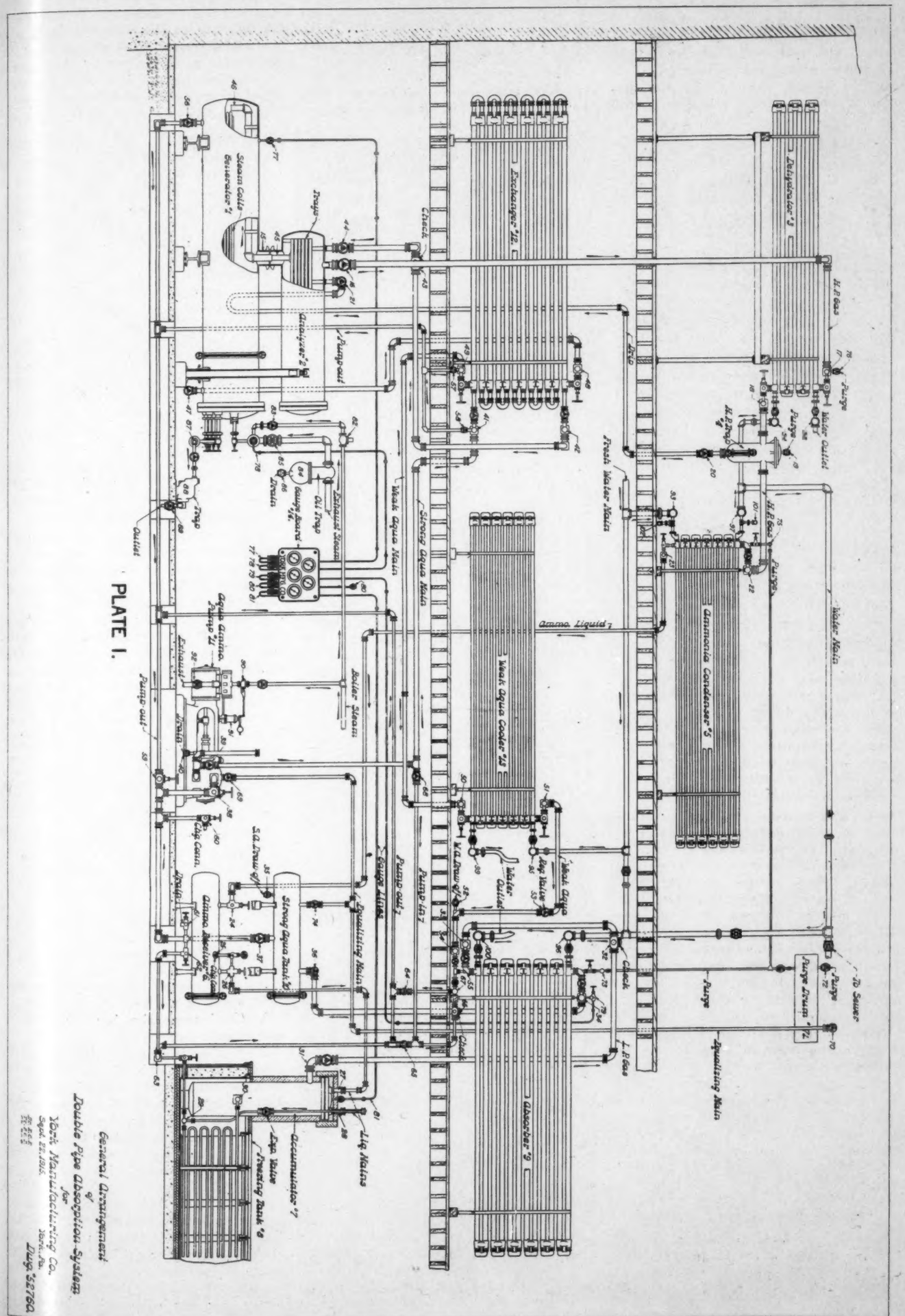


PLATE I.

General Arrangement of Double Pipe Absorption System for York Manufacturing Co. York, Pa.

Sept. 22, 1926.

Dwg. 52760

cooler at the proper point; as a result of this the weak liquor becomes enriched or strengthened by the ammonia gas and forms strong liquor. This strong liquor is drawn from the bottom of the absorber by the ammonia pump, which discharges it into the exchanger, where it circulates around the coils containing the weak liquor and then passes into the generator.

The exchanger is simply a heat exchanger and answers the same purpose as a feed-water heater in a steam-boiler plant: it heats the strong liquor on its way to the generator and cools the weak liquor on its way from the generator to the absorber. The strong liquor is now back in the generator ready for re-distillation, thus completing the cycle.

Operation of Exhaust Steam Absorption Refrigerating Machine.
Producing 0°-5°-10°&-15° F. Brine.

Column Numbers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Condensing Gauge Pressure	105	105	105	105	115	115	115	115	125	125	125	125	135	135	135	135	145	145	145	145	155	155	155	155	165	165	165	165	180	185	185	185	190	195	195	195
Temperature Gas Leaving Dehydrator	86	86	86	86	90	90	90	90	94	94	94	94	98	98	98	98	102	102	102	102	105	105	105	105	110	110	110	110	115	115	115	115	118	118	118	118
" Brine Entering Brine Cooler	+5	0	-5	-10	+5	0	-5	-10	+5	0	-5	-10	+5	0	-5	-10	+5	0	-5	-10	+5	0	-5	-10	+5	0	-5	-10	+5	0	-5	-10	+5	0	-5	-10
" " Leaving " "	0	-5	-10	-15	0	-5	-10	-15	0	-5	-10	-15	0	-5	-10	-15	0	-5	-10	-15	0	-5	-10	-15	0	-5	-10	-15	0	-5	-10	-15	0	-5	-10	-15
Gal's Brine Circulated per Min. per Ton Refg.	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
" " " " " " 150 " "	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130
Brine Cooler Ammonia Pressure	86	57	32	1	86	57	32	1	86	57	32	1	86	57	32	1	86	57	32	1	86	57	32	1	86	57	32	1	86	57	32	1	86	57	32	1
Absorber "	5	2	0	-2	5	2	0	-2	5	2	0	-2	5	2	0	-2	5	2	0	-2	5	2	0	-2	5	2	0	-2	5	2	0	-2	5	2	0	-2
Temp. of Strong Aqua Leaving Absorber	75	75	75	75	75	75	75	75	80	80	80	80	80	80	80	80	80	80	80	80	85	85	85	85	90	90	90	90	90	90	90	90	95	95	95	95
Strength Baume Strong Aqua "	25.6	24.5	23.5	22.4	23.0	22.0	21.0	20.0	22.5	21.5	20.6	19.6	21.9	20.9	19.9	19.0	21.3	20.3	19.4	18.5	20.8	19.8	18.9	18.0	20.3	19.3	18.4	17.5	19.8	18.8	17.9	17.0	19.3	18.3	17.4	16.5
Generator Steam Gauge Pressure	1	3	5	5	1	3	5	10	5	8	10	15	5	8	10	15	5	10	15	20	10	15	20	25	15	20	25	30	20	25	30	35	25	30	40	50
Strength of Weak Aqua Leaving Generator	25.0	24.0	23.0	21.9	22.5	21.5	20.5	19.5	22.0	21.0	20.1	19.1	21.4	20.4	19.4	18.6	20.8	19.8	18.9	18.0	20.3	19.3	18.4	17.5	19.8	18.8	17.9	17.0	19.3	18.3	17.4	16.5	18.8	17.8	16.9	16.0
Lbs. Strong Aqua Circ. per Min. per Ton Refg.	3.45	3.61	3.81	3.97	3.78	3.91	4.08	4.28	3.91	4.07	4.22	4.44	4.07	4.22	4.39	4.62	4.27	4.42	4.58	4.77	4.48	4.63	4.80	4.99	4.69	4.85	5.03	5.22	4.91	5.07	5.26	5.46	5.14	5.32	5.52	5.73
" " " " " " 150 " "	5.51	5.65	5.76	5.91	5.61	5.80	5.93	6.11	5.80	6.03	6.27	6.58	6.04	6.27	6.51	6.86	6.33	6.56	6.79	7.07	6.65	6.86	7.12	7.40	6.96	7.20	7.46	7.75	7.29	7.52	7.80	8.10	7.62	7.89	8.19	8.50
Gallons " " " " " "	5.91	5.59	5.69	5.76	5.98	5.96	5.85	5.87	6.05	5.98	5.93	5.96	6.13	6.09	6.04	6.06	6.25	6.22	6.22	6.24	6.45	6.42	6.42	6.43	6.66	6.62	6.63	6.65	6.88	6.85	6.86	6.88	7.11	7.09	7.11	7.13
" " " " " " 150 " "	7.34	8.34	9.12	10.2	8.92	8.76	8.13	8.71	9.15	9.05	9.16	9.66	10.5	10.6	10.8	11.3	11.4	11.9	12.4	13.0	12.1	12.4	12.9	13.5	12.6	13.0	13.6	14.2	13.2	13.7	14.3	15.0	14.0	14.6	15.3	16.0
G.P.M. of 9x18" Aqua Pump per Ton Refg.	1.04	1.18	1.29	1.44	1.26	1.24	1.15	1.23	1.29	1.28	1.30	1.37	1.49	1.50	1.53	1.60	1.61	1.68	1.75	1.84	1.71	1.75	1.82	1.91	1.78	1.84	1.92	2.01	1.86	1.94	2.02	2.12	1.98	2.07	2.16	2.26
" " " " " " 150 " "	1.04	1.18	1.29	1.44	1.26	1.24	1.15	1.23	1.32	1.28	1.30	1.37	1.55	1.50	1.53	1.60	1.67	1.68	1.75	1.84	1.77	1.75	1.82	1.91	1.84	1.84	1.92	2.01	1.92	1.94	2.02	2.12	2.04	2.07	2.16	2.26
Lbs. Anhydrous Ammo. Required per min. per Ton Refg.	.403	.464	.505	.564	.494	.485	.450	.482	.506	.501	.509	.536	.584	.587	.599	.627	.630	.658	.686	.722	.671	.686	.713	.748	.697	.721	.752	.787	.728	.759	.790	.830	.777	.810	.844	.884
Temperature Weak Aqua Entering Absorber	70	70	70	70	70	70	70	70	75	75	75	75	75	75	75	75	80	80	80	80	85	85	85	85	90	90	90	90	90	90	90	90	95	95	95	95
Gals. Water per Min. per Ton Refg. on Condenser	2.34	2.56	2.74	2.96	2.74	2.85	2.95	3.05	2.74	2.85	2.95	3.05	2.74	2.85	2.95	3.05	2.74	2.85	2.95	3.05	2.74	2.85	2.95	3.05	2.74	2.85	2.95	3.05	2.74	2.85	2.95	3.05	2.74	2.85	2.95	3.05
" " " " " " Dehydrator	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
" " " " " " " " W.A. Cooler	.63	.74	.79	.88	.76	.75	.7	.75	.7	.8	.79	.84	.72	.76	.8	.84	.75	.8	.84	.89	.79	.82	.86	.91	.83	.86	.91	.96	.87	.91	.95	1.01	.92	.96	1.01	1.06
" " " " " " " " Absorber	2.55	2.6	2.65	2.65	2.55	2.55	2.55	2.61	2.61	2.65	2.69	2.73	2.65	2.69	2.72	2.78	2.78	2.81	2.84	2.87	2.84	2.87	2.89	2.92	2.89	2.92	2.94	2.97	2.94	2.97	2.99	3.02	2.99	3.02	3.04	3.07
" " " " " " " " Total	5.48	5.84	5.9	6.04	5.81	5.88	5.80	5.98	5.85	5.98	6.06	6.25	6.01	6.17	6.31	6.50	6.23	6.39	6.55	6.74	6.43	6.58	6.75	6.94	6.64	6.81	6.99	7.18	6.85	7.03	7.21	7.41	7.08	7.27	7.46	7.67
" " " " " " 150 Tons Refg.	549	576	590	604	581	588	580	598	585	598	606	625	601	617	631	650	623	639	655	674	643	658	675	694	664	681	699	718	685	703	721	741	708	727	746	767
Temperature of Waterron Condenser	50	50	50	50	50	50	50	50	55	55	55	60	60	60	60	60	65	65	65	65	70	70	70	70	75	75	75	75	80	80	80	80	85	85	85	85
" " " " " " Dehydrator	62	62	62	62	66	66	66	66	70	70	70	70	74	74	74	74	77	77	77	77	80	80	80	80	88	88	88	88	92	92	92	92	90	90	90	90
" " " " " " Weak Aqua Cooler	50	50	50	50	55	55	55	55	60	60	60	60	65	65	65	65	70	70	70	70	75	75	75	75	80	80	80	80	85	85	85	85	90	90	90	90
" " " " " " Absorber	62	62	62	62	66	66	66	66	70	70	70	70	74	74	74	74	77	77	77	77	80	80	80	80	90	90	90	90	90	90	90	90	90	90	90	90

Measurement of Refrigerating Effect

The commercial unit of refrigeration is the "ton of refrigeration," which is the number of British Thermal Units required to melt one ton (2000 pounds) of pure, solid ice. The latent heat of ice is 144 B.T.U.'s. Therefore,

One ton of refrigeration=144x2000 or 288,000 B.T.U.'s. Since all calculations involved in refrigerating-machine operation are based on a 24-hour day, consequently machine capacities are figured at the rate of 12,000 B.T.U.'s per hour or 20 B.T.U.'s per minute. Or, as the manufacturers of refrigerating equipment rate their machines: *a compression of 5 cubic feet of ammonia gas perminute from a suction pressure of 15 pounds to a condenser or head pressure of 185 pounds represents a machine capacity of one ton of refrigeration per 24 hours.*

Maintaining Peak Capacity

The average refinery executive, resident engineer or refrigerating engineer or operator is usually concerned not so much with the theories of refigeration, advantages and disadvantages of various types and makes of machines; the various construction details entering into the "make-up" of a particular machine and similar matter, as he is with the more common practical problem of maintaining the original peak capacity of a machine after it has been installed and has been in opertion for a period of time.

It is this latter subject, maintaining refrigerating - machine capacity, that therefore, will constitute the remainder of the subject matter.

When a machine of the ammonia-absorption type begins to "fall off" in refrigerating capacity, same may be due to either one or more of the following causes:

1. Insufficient water supply.
2. Insufficient steam pressure.
3. Insufficient flow of brine.
4. Insufficient ammonia charge.
5. Presence of air or non-condensable gases in machine.
6. Condenser, absorber or rectifier coils are dirty.
7. Cooler is in need of purging.

Machine capacity can be checked by calculating the actual number of B.T.U.'s being removed from the oil that the brine is chilling.

Insufficient Water Supply

A regular quantity of water is necessary for the successful and uniform operation of any type of refrigerating machine. This is a requisite of major importance. Parenthetically, it might be stated that, if there is any choice, the coldest water available should always be selected.

Table 1 shows the quantities of water per ton of rated refrigerating

capacity of the machine that, in general, are recommended by the Carbondale Machine Company in connection with the operation of any of their various types of refrigerating machines:

TABLE 1

Quantities of Water Required for Operation of Refrigerating Machines

(Courtesy of Carbondale Machine Company)

If the water temperature is 50 degrees, use 2 gallons per minute per ton.

If the water temperature is 60 degrees, use 2½ gallons per minute per ton.

If the water temperature is 70 degrees, use 3¼ gallons per minute per ton.

If the water temperature is 80 degrees, use 4¼ gallons per minute per ton.

If the water temperature is 90 degrees, use 6 gallons per minute per ton.

In some instances, it is possible to operate the machine efficiently with lesser quantities of water than the amounts indicated Table 1; while sometimes a distinct betterment of economy can be effected by using more water.

Under no circumstances should the outlet water from the absorber ever exceed 95 to 100 degrees F. Mention has previously been made of the fact that a portion of the water coming from the absorber is used to cool the rectifier. Sufficient water should always be used to keep the gas leaving the rectifier from 20 degrees to 30 degrees F. warmer than the ammonia condensing temperature due to the generator pressure.

Table 2 shows the temperatures between which the rectifier outlet gas should be held:

TABLE 2

Temperatures Between Which Rectifier Outlet Gas Should be Held

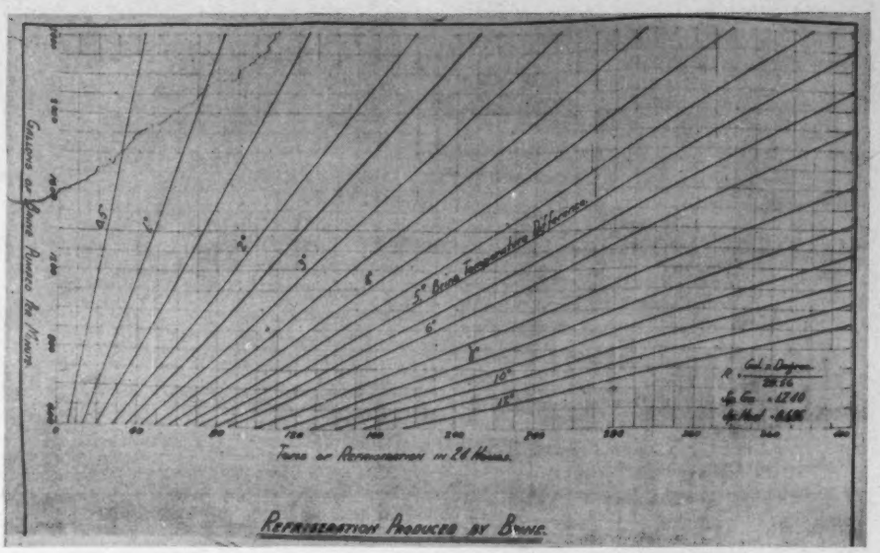
(Courtesy Carbondale Machine Company)

Water Temp. °F.	Generator Gauge Pressure lbs. sq. in.	Temp. Gas leaving Rectifier °F.
50	105	86 to 96
60	125	95 to 105
70	145	102 to 112
80	166	109 to 119
90	192	118 to 128

It will usually be found that when the rectifier is operating under normal conditions, that is, when the rectifier is clean and a plentiful amount of water is being provided, the shortest drip pipe will be very hot; the intermediate pipe or pipes successively cooler; while the longest pipe will be fairly cool to the hand.

Insufficient Steam Pressure

Dependent upon the design of the particular machine, the steam pressure will generally vary between 3 pounds with 0 degrees F. brine and 60 degrees F. water to 50 pounds or more with 20 degrees F. brine and 80 degrees F. water. Usually the steam pressure must be increased if the brine temperature is lowered or if the cooling water temperature is raised and, ordinarily, the steam pressure should never be in excess of one-third of the generator pressure.



When the steam pressure is too low, the aqua ammonia in the generator is not heated to a sufficiently high temperature and, consequently, not enough ammonia as is evolved to maintain the normal capacity of the machine.

Insufficient Flow of Brine

Calcium chloride brine used as a circulating medium for heat transfer should have a specific gravity of about 1.225-1.250.

To obtain the rated capacity of a refrigerating machine, other operating factors being normal, it is necessary to circulate through the cooler at least from 2½ to 5 gallons of brine per minute per ton of refrigerating capacity of the machine.

If the brine solution becomes too weak, the cooler coils are apt to freeze. This would be indicated by a sudden stoppage of the brine pump, if this pump is of the displacement type. In such a case, the gas valve between the cooler and the absorber should be immediately closed, while the expansion valve should be opened wide for at least five minutes. This should heat the brine sufficiently to thaw it and to permit the pump to start. If the cooler coils freeze, it is well to shut off the steam entering the generator until the cooler has been thawed out.

Insufficient Ammonia Charge

Frequently, failure to attain rated refrigerating-machine capacity is due to an insufficient ammonia charge.

In the ammonia-absorption system, aqua ammonia is contained in the generator, exchanger and absorber; and anhydrous ammonia, in the condenser and cooler.

With the machine is regular operation and a normal ammonia charge, the following conditions should exist (for efficient operation of the machine) as indicated by the gauge glasses on the various shells:

1. *Generator*—The generator should have from 1 to 2 inches of liquor covering the coils.

2. *Tubular Absorbers*—Tubular absorbers should have about 1 inch of aqua ammonia over the top of the top row of tubes.

3. *Atmospheric and Double-Pipe Absorbers*—Atmospheric and double-pipe absorbers should have at least 12 inches of aqua ammonia in the aqua receiver above the pump suction connection.

4. *Shell Absorbers*—Shell Absorbers should run almost empty and the gauge glass should show aqua ammonia as nearly as possible level with the lower flange joint of the shell and head.

5. *Shell Condenser*—The shell condenser should show from 4 to 6 inches of anhydrous ammonia in the gauge glass, while the receivers of atmospheric or double-pipe condensers should show a similar amount in the gauge glass above the outlet to the expansion valve, or at least sufficient to cover the outlet so that the gas can not blow through.

6. *Brine Cooler* — The brine cooler should have enough anhydrous ammonia in it to frost over both gauge cocks, and should show a flash of soapy liquid in the glass when the gauge cocks are opened. The gas line should be slightly frosted back to the absorber, but this, however, should never frost sufficiently to show frost on the purge line. The presence of frost on this purge line would indicate that liquid ammonia was being carried out of the cooler.

It is not necessary to know the strength of the strong and weak aqua ammonia to determine whether or not the machine is sufficiently charged for, if the conditions as just mentioned are met, the strength of the strong and weak aqua will take care of themselves. Having determined the proper levels in the different vessels, it is advisable to tie a string around the

gauge glasses so that any changes from the normal levels will be indicated at once.

Presence of Air or Non-Condensable Gases

It is self-evident that the presence of air or non-condensable gases in a refrigerating system will result in a decrease in the capacity of the machine.

When a refrigerating machine is first placed in operation, it is necessary to remove air quite frequently; thereafter, however, removal of air usually from two to three times a year will suffice, providing the machine is run 24 hours per day and the brine temperature is not carried much below 10 degree F.

The presence of air or non-condensable gas in the high pressure side of the machine is indicated by a high generator pressure existing in spite of the fact that the condenser coils are clean and there is an ample water supply.

Although air can be removed from the system while the machine is in operation, more satisfactory results are obtained if the machine is shut down and the air then removed.

Dirt

"Dirty coils" is the most frequent cause of a "falling off" of machine capacity. For efficient results it is absolutely essential to keep clean the condenser, absorber, weak liquor and rectifier coils. With ordinary well or river water these coils should be cleaned at least once a month. However, if the water is muddy, they should be cleaned once a week or even oftener, if necessary. Lack of space prevents giving at this time a detailed description of the most efficient methods of cleaning these various types of coils.

Cooler in Need of Purging

"Purging the cooler" is the term applied to the removal of aqua ammonia from the cooler. This operation may be necessary once a week or, then again, not for three or four months.

If there is a lack of capacity that can not be attributed to other causes and the gauge cocks on the cooler are frosted as with a normal charge; if the cooler pressure is two or three pounds lower than that shown in Table 3; if, on opening the cooler gauge cocks, the liquor looks watery and sluggish—under such conditions, then, the cooler needs purging.

TABLE 3

Cooler Gauge Pressures Corresponding to Different Outlet Brine Temperatures

(Courtesy Carbondale Machine Company)

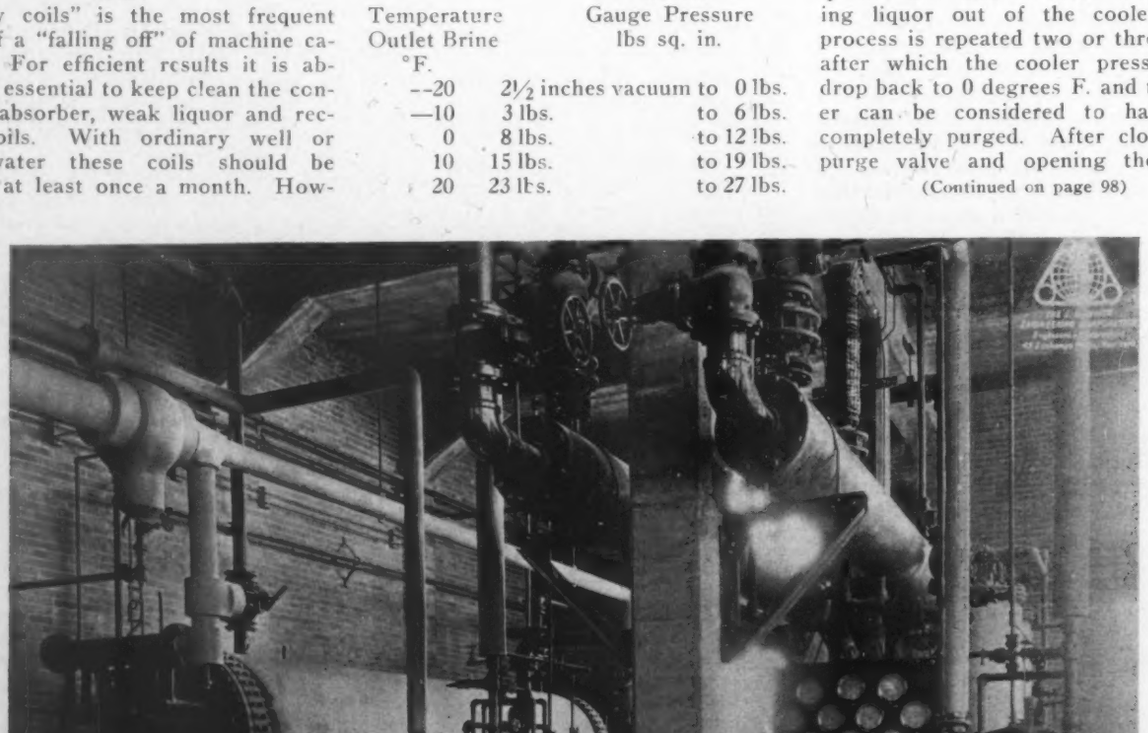
Temperature Outlet Brine °F.	Cooler Gauge Pressure lbs sq. in.
--20	2½ inches vacuum to 0 lbs.
—10	3 lbs. to 6 lbs.
0	8 lbs. to 12 lbs.
10	15 lbs. to 19 lbs.
20	23 lbs. to 27 lbs.

When purging is necessary the purge line is also apt to be frosted, although this can also be the result of feeding too much anhydrous ammonia through the expansion valve.

To remove aqua ammonia from the cooler, the expansion valve is first closed and as much gas as will do so is allowed to pass over through the cooler gas line. At the end of about 15 minutes the valve on the cooler gas line is closed and the purge valve is opened, as a result of which all the liquor will drain out of the cooler into the absorber. At first the pressure in the cooler will rise, but after a few minutes it will gradually fall. During the purging operation the ammonia pump should be run slowly and the liquor be allowed to accumulate in the absorber, or the aqua receiver, as the case may be. This will prevent the pump from losing its suction and becoming "gas-bound." During purging, it is also important that water be kept circulating through the absorber; likewise, some weak liquor should also be circulated.

After the cooler has been well drained-out, the expansion valve should be opened for about half a minute. This will increase the pressure slightly and will tend to force the remaining liquor out of the cooler. This process is repeated two or three times, after which the cooler pressure will drop back to 0 degrees F. and the cooler can be considered to have been completely purged. After closing the purge valve and opening the cooler

(Continued on page 98)



Portion of refrigerating room, Parco refinery, showing Sharples dewaxing plant.

Technological Control of Refinery Process

By ERNEST B. PHILLIPS[1] AND ALBERT E. MILLER[2]

Part Two

LET us now turn our attention to the investigations of new processes brought to the attention of an oil company by an outside party or group. This is not to be confused with the investigation of new processes developed within the company itself and which was discussed earlier in the paper.

Processes, and by these I mean apparatus, auxiliary equipment or products which are brought to the notice of oil companies, range all the way from mere ideas, without even a definite plan in the mind of some inventor, to complete commercial propositions, often fully developed and fully protected by patents. Such processes may cover most any subject. A few of those which come regularly to the technical head of any oil company are processes for cracking oil, processes for producing or recovering sulphuric acid, manufacture of soaps and greases, vacuum distillation processes, new types of pumps, oil burners, or investigations of deposits of Fuller's earth.

Usually, there are three persons to be considered in any new proposition. They are the inventor, his financier, who is also sometimes his promoter, and his lawyer. As a rule, the idea is first brought to the technical executive by letter or in the form of an interview. In the majority of cases, the new proposition is disposed of at this first contact, as most of them are not practical or of any value in the light of the experience of the man in charge of this department. By asking a few well-chosen and pertinent questions, the whole matter is often ended as far as the oil company is concerned. If, however, the idea presented is of sufficient importance that the proposition must be investigated, then the technical man must be called in and probably arrangements are made for a demonstration of the process. If the new proposition is in the form of a product, samples may be sent to the central laboratory and there investigated. According to the degree of development of the idea and the scale on which it can be demonstrated, one man, or probably a technical man and several helpers, will be sent to the location of the plant or apparatus to be investigated and a preliminary opinion obtained as to the merits of the proposition.

In reporting an investigation of this nature, the report should be divided into two parts: First, a letter to the head of the technical department or to the person to whom the report is to be made, and second, the report proper covering the results of the preliminary investigation. The letter should be brief and should merely state name of the process, date of investigation, those present, with their connections, and the location of the plant where the investigation took place. Attached to the letter should be the report of the investigation. The report may well be divided into the seven following classes of information as regards the process:

1. Historical.
2. The process in its present development.
3. Record of the demonstration made by the investigator.
4. Commercial application of the process.
5. Comparison with other known similar processes.
6. Advantages and disadvantages of the process.
7. The investigator's personal remarks on the process, and his reasons for recommending its adoption or rejection.

The following may serve as an amplified outline of a report of a cracking process. This outline really covers the questions, answers to which should be secured, so that the technical head will have as much information on which to base judgment as to whether or not the preliminary contact with the process should be followed up and a complete demonstration made:

Historical (1)

1. Who was the inventor, when did he first get his idea and how did he conceive it?
2. The inventor's present development of the process, where did he do his experiments and to what extent did he develop his ideas (laboratory or commercial scale).
3. How did the inventor finance the development of his invention? Did the inventor form a company to develop or exploit the process? If so, give the name of the company, his present contract with it, the men interested, the location of the main office and in what state the company is incorporated? (Why).
4. What has the company done to develop the process commercially? Who owns it now? Is the process patented? If so, who owns the patent? If in litigation? If so, with whom? Get the number of the patent and the number of patents and names of the patentees with whom there is litigation.
5. Will the company or inventor sell the process outright, or will they allow the use of the process on a royalty basis?
6. Who else has investigated the process? What did they think of it, and, if possible, get a copy of their report.
7. Is the process being used by anyone else? If so, what royalty do they pay and what are the terms of their contract with the owners of the process?

The Process in Its Present Development (2)

1. Is the process as practiced at present in the laboratory, semi-commercial or commercial state?
2. Give a description of the apparatus used, with blue print or photostat, if possible. Obtain also photographs and an operating flow sheet.
   (a) Still shell, size, material, etc.
   (b) Type of tubes, length, size and material.
   (c) Mechanical agitator, if any—type, speed of agitation and type of drive.
   (d) Size and type of pumps, steam boilers, etc.
   (e) Vapor line and reflux towers.
   (f) Type of condenser, whether under pressure or without.
   (g) Casing head plant or absorbent towers for non-condensible gases.
3. General Operation:
   (a) Whether a continuous or batch process.
   (b) Stock charged, gravity, initial and other general tests.
   (c) The capacity of the still, rate of charging per hour or minute, feed pump and control.
   (d) Pressure used and how controlled.
   (e) Preheaters and forewarners.
   (f) Fire box, type and construction and insulation.
   (g) Circulation from bulk supply; type of artificial circulator.
   (h) Re-cycling.
   (i) Control of run and taking off vapors.
   (j) Condenser and run down tanks.
   (k) Total heating surface of still or tubes (gals. of distillation per hour, per square foot of heating surface).
   (l) Fuel used, whether gas, coal or oil, and quantity burned per hour and per gallon of distillate made.

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[1]Chief Chemist, Sinclair Refining Company, East Chicago, Indiana.

[2]Process Chemist, Sinclair Refining Company, 45 Nassau Street, New York. Paper read before the American Institute of Mining and Metallurgical Engineers, New York Meeting, 1928. Copyright by the American Institute of Mining and Metallurgical Engineers, Inc., 1928.

(m) Any special features, such as catalysts, special methods of handling the carbon problem or any special feature of construction.

Record of Demonstration Run (3)

1. Condition under which run was made:
(a) Condition of the plant.
(b) Superintendent and helpers.
(c) Oil stock used with complete tests of same.
(d) Whether run was made continuously or batch?
(e) Length of run, whether in one period or in shifts?
(f) Data to be taken during the run.
(g) Personal checking up of quantities of raw material handled, capacity of tanks and feeding rates.
(h) Provide some method for checkig up fuel consumption.

2. Log of run. Time, important data taken, readings of instrument and remarks or observations made.

3. Yields:
(a) Grade.
(b) Volume in gallons or bbls.
(c) Weight in pounds.
(d) Percentage by volume based on distillate.
(e) Percentage by volume based on original stock.
(In this run shall be included each finished product made, the amount of coke produced and the loss in fixed gases.)

4. Quality of products:
(a) Comparison with original stock (Fractional distillations, physical and chemical tests and graphs).
(b) Do the products need rerunning or refining?

5. Rerunning of Products from the Still:
(a) Operation.
(b) Apparatus.
(c) Length of the log (duration of run in hours).
(d) Yield of poducts.

6. Refining of Products:
(a) Method.
(b) Apparatus.
(c) Yields and losses in treating. Special problems.

7. Fuel Efficiency:
(a) Total fuel burned.
(b) Pounds of fuel consumed per gallon of oil run through process of distillate made, and pounds of fuel per gallon of gasoline made.
(c) Efficiency of fire box.
(d) Temperature of waste fuel gases (analysis of these gases if possible).
(e) Preheaters or forewarmers and gain in temperature from their use.
(f) Temperature of residual oil drawn off or circulating through exchangers.

8. Efficiency of Process:
(a) Capacity of units—gallons of barrels.
(b) Rate of charging in gallons per hour.
(c) Barrels of distillate per square foot heating surface.
(d) Average rate of distillation, rate percentage per hour based on the charging capacity of the still.

9. Cost balance.
(a) Cost of raw material used per ton or per barrel oil run.
(b) Value of products made.
(c) Cost of raw material charged to still or used up.
(d) Value of products made or of unusued material left over.
(e) Value of fuel consumed.
(f) Labor cost.
(g) Total investment in the plant.
(h) Maintenance 10 per cent of investment.
(i) Interest on investment.
(j) Allow for depreciation at proper rate.
(k) Cost of steam and electricity.
(l) Total cost of producing — gallons of gasoline.
(m) Total value of products made.
(n) Net profits per day or year.
(o) Barrels of gasoline per year per dollar invested.
(p) Profit per year per dollar invested.

Note: If there are several runs, tabulate parallel and average; example.

Item	Run 1	Run 2	Run 3	Av.

Commercial Application of Process (4)

1. If on a laboratory scale how does inventor propose to operate the process commercially?
2. What is the largest size of units possible?
3. Will the plant be built in separate units or batteries?
4. Will it be operated as a continuous process or intermittently?
5. The total investment will be so much. You can charge so many barrels per day and the yield will be so much of such and such a product.
6. Do the products need rerunning or refining in order to make them marketable?

Comparison With Similar Processes (5)

1. Chemical process.
2. Cracking process.
3. Treating process.

Note: Compare the process with other known processes with respect to investment, size and yields, fuel, economy, yield of gasoline per heating surface, cost per gallon, labor operation, safety from fire and explosion, rate of distillation and quality of products.

Advantages and Disadvantages (6)

1. Large or small capacity of plants.
2. High or low yields.
3. Obsolesence.
4. Fuel economy.
5. Quality of products.
6. Safety.
7. Depreciation and maintenance.
8. Simplicity of construction and operation.
9. Amount of labor needed for operation.
10. Do you need special castings or equipment or can the plant be built from standard parts?
11. Elasticity of the process or range of oils that can be used as stock.
12. Range of products obtained.
13. Is the loss in fixed gases large or small, and what is the nature of these gases?
14. Is there a large loss in coke and does the formation of carbon place difficulties in the way of operation?

The first investigation of a process or contact with a new idea is practically an effort to obtain as much reliable information as possible regarding the proposition submitted. A consideration of this preliminary report then puts the technical head of an oil company in a position where he can decide whether or not the propostion is worthy of further consideration. In case this conclusion is reached, arrangements are usually made for a second demonstration. This should be on a semi-commercial scale or even commercial scale, if possible. Enough men should be sent under some head technical man familiar with this line of work to take over the proposition and operate it over a long period of time, with the company's own men operating on their own oil and keeping their own data. No run should be shorter than 24 hours. It is not necessary to go into details as to the method of conducting such a test. One would, of course, obtain not only the information furnished in the preliminary report, but carry the figures far enough so that there will be complete yield, fuel cost, and other figures available for final study.

The technical man should not, however, overlook one important fact in conducting such a test in another man's plant. He must take into consideration the fact that the average inventor or party developing a new process has not the varied experience, or, we might better say, the specialized experience in oil refining that he has, and usually one must bear in mind that with the facilities of his own company and their experience at his demand, considerable improvement could be made in the construction and operation of the plant, and probably more efficient heating means, condensing means, and auxiliary equipment could be employed. The investigator must always report the process as it acutally is and the products as they are actually produced, but it is a good thing to also advise his chief as to the possibilities of the process and what one experienced in the oil industry could make out of it. As mentioned above, inventors often present processes to an oil company, but due to circumstances, usually financial, they are not in a position to build any plant or to make a demonstration. In such a case, the ideas, if they look worthy of consideration, are developed on a sort of co-operative basis by the inventor and the oil company.

Prior Art Searches

As mentioned several times earlier in this paper, one of the most important phases of technical control in the oil industry and one that is becoming every day more and more important is the subject of prior art searches. These searches must be conducted almost continuously for either one of two purposes. First, the prior art should be

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searched thoroughly to see what patent protection, if any, can be given new ideas which are conceived in the research, process development department, operating, or any other part of the organization. These ideas may be along the line of a new process, may cover some new piece of equipment of apparatus, or may be a new product or composition. Second, it is always advisable to know from a study of the prior art if one is within his rights in operating a regular refinery process, or whether he is liable to litigation for infringing somebody's patented process. The oil industry has moved in cycles and has seen many changes in the manner of operating and in just what at any particular time is considered the important product. This has lead to the rather complicated patent situation at present. It is not within the scope of this paper to discuss this particular phase of the subject further.

Due to the difference in purpose of the two above mentioned kinds of prior art searches, the technique of carrying out the search is a little different in each case. When one is studying the prior art, it is best to make the search as systematic as possible and to keep the results of the search in a definitely classified manner, so that they are readily available to patent attorneys or such others as may have to study or refer to them later. In making what is known as a prior art search to see what production can be given a new idea, the entire field of that particular idea must be searched, but in making the second class of search, where one simply wishes to see whether or not the processes which he is already operating are old art, the search is usually made to find instances in the prior art which anticipate certain definite ways of operating a process or constructing a piece of apparatus in which one wishes to carry out a process. The writers have found the following a very convenient system for conducting a prior art search and for reporting it in a classified, readily available manner.

The search proper may be divided into two main parts:

Part I—Covering material searched or studied, and

Part II—Containing references found pertinent to the subject on which prior art is desired.

It is well to divide the material searched into sections, such as the following:

Section A—Books.

Section B—Periodicals.

Section C—Patents.

Section D—Miscellaneous publications, such as, Dissertations, Bulletins, Brochures, and such as are not books or regular publications.

Section E—Reports, Affidavits, and other unpublished matter.

In each one of these sections, the material searched can be entered and given numbers so that they can be referred to later, and also for the purpose of cross entries which are made in the second part of the search under "References Found." In other words, each book, periodical or patent studied will have a symbol and this can be used for identification in the actual references found.

It is very essential in a search of this nature that any literature source studied be entered in its proper section, giving enough detail on the reference that it can be readily located again in case those receiving the results of the search wish to study the original reference. In the case of a general search on a given subject for the purpose of obtaining protection for an idea, it is often sufficient to merely make an abstract of the literature reference and enter it under the proper section of material searched, giving it its proper item number under that section, but in case a search of the second class on specific points is conducted, it is better to use the two-part search idea, the first part being the sections of material searched and the second part a list of the classes under which the references found are divided. In this case the abstract prepared from a study of the original reference and which is entered under the proper section of material searched contains at the end a list of class references, in case there are any, together with the item number in that class. The purpose of classification is that where a pertinent reference is found it can be entered and elaborated under the proper class so that, at the end of a search, one studying the subject on which the search was made can find all the refences pertaining to any particular angle of the subjected abstracted and listed in one place, with each item containing a cross reference back to the original source from which the information was obtained.

Searches of the nature outlined above should be carried out by some technical man familiar with the standard processes carried on in oil refineries and with research work in the oil industry. After he has completed his search, the results should be turned over to regular patent attorneys as they can best judge of the legal aspects of the matter.

One advantage of carrying out a search along the lines described above is that the search is accumulative and new items of material searched and references found can be incorporated at will. If the search is extensive and covers the literature, both of the English and foreign language and all of the patents as well, it may become quite a volume, in which case it is advisable to prepare an author index. Each entry should be given the search symbol under material searched, so that the reference can be immediately found if desired.

Conclusion

In considering the operations of the technical staff for a modern unit in the petroleum industry, we have covered a field that requires the annual outlay of a large sum of money. The natural question here is: "Does this expenditure justify itself?" The returns from such an investment appear in two forms, one tangible and the other intangible. Bogey barrel workups induce both. Routine operators in any kind of a plant are content with current yields as long as stocks do not cause trouble in the specific operations with which they are concerned. A stillman wants throughput; a treater, freedom from trouble at the agitators and a wax plant man, good pressable distillate. When no laboratory control whatever is maintained over operations, each process yield is considered satisfactory in comparison with previous operations. If, however, operators know that control breakups of stocks for full potential yields are to be made on the exact materials they handle each month, the natural tendency will be to watch details of operation, quality of products and yields closely to avoid censure from the superintendent. The value here is intangible, but nevertheless, it repreesnts thousands of dollars per year in reduced refinery costs and in ultimate earnings.

In another direction, bogey barrel workups have a substantial value. A superintendent cannot demand greater yields per barrel of crude run from his operators unless he can lay before them positive evidence that that crude actually contains those added quantities. When breakups are made on specific stocks charged to stills and results are set up against refinery yield statements, defects in commercial operations are discovered. This kindles the interest of the foreman on the job and spurs them on to get the highest yield and quality possible from the materials they handle. In many cases, yields lost in primary operations can be recovered in secondary ones, but this means a waste of a certain amount of fuel and a loss in still capacity, both of which considerations run up the overall operating costs. The ideal operation is to separate all the desirable products in continuous one pass operations and the nearest approach possible to this ideal is the prime object of bogey barrel control. Practically complete separation of test distillates in one pass operations as against poor fractionation and secondary clean up may mean as much as five cents per barrel of crude run in savings. There can be no question but that such a saving justifies all the expense involved. Bogey barrel runs supply the means for finding out where improvements in yields can be expected and serve as a checkup after better operating conditions have been established.

Passing to the semi-commercial operation with actual or proposed plant processes, this class of work reveals the shortcomings of current equipment and points the way to improvements. Here, individual steps can be followed in minute detail and the degree of refining obtained, closely watched. In many cases, the causes for the failure of end products to meet exacting specifications can be located and the plant equipment modified with a modest outlay of capital. Much more valuable re-

(Continued on page 102)

SPRING MEETING OF EASTERN REFINERS

N. P. A. Has Most Successful Semi-Annual Meeting

INCREASED interest in the activities of the refining industry and the problems pertaining to manufacture, marketing, and the economics of this industry was indicated by the large attendance at the semi-annual convention of the National Petroleum Association at Cambridge Springs, Pennsylvania, April 19 and 20. Attendance records surpass any previous semi-annual meeting of this organization, and the enthusiastic reception of the papers presented and subsequent discussion of the varied subjects was evidence that the Eastern refiners are determined to continue their successful cooperative efforts toward securing better efficiency and greater economy in the manufacturing branch of the industry.

Among the important problems discussed at the convention were those of cost accounting, safety work, welfare and insurance, fire prevention, uniformity in testing, economy in combustion, effect of fractionation on the chemical treatment of products, pipe stills and fractionating columns, volatility and distillation of motor oils, and the activities of the association's various departments. Fundamental research in petroleum, vital statistics with reference to stocks on hand in Eastern refineries, the progress of the Fire Marshal's Association, and the training of men in first aid work, were also subjects of much interest to those present.

E. M. Lyons, president of the association, opened the first session with an address pointing out that the present year offers promise of greater prosperity to the refiner. "Over production has been our basic trouble," said Mr. Lyons. "Today there is a better feeling in the industry, since demand is increasing and the price structure covering most of our products has moved upward since the first of the year." He commended the association and its membership upon the wonderful spirit of cooperation which has been built in it through its activities and the work of the various departments of the organization.

At the fellowship dinner, Thursday night, O. P. Keeney, who has been president of the association three times, and is now trustee in charge of the department of membership and relations, was presented with a six piece silver service in appreciation of his interest and activities in behalf of the association. E. M. Lyons, now president, made the presentation speech.

A. W. Scott, Empire Oil Works, Oil City, Pennsylvania, trustee in charge of department of standards and tests told of the work of 65 laboratories collaborating in tests of samples collected occasionally for the purpose of bringing the laboratories to a better standard. "How to Secure Greater Uniformity in Testing" was the title of a paper presented by Dr. Charles V. Bacon, in which he made a plea for more confidence in the tests of the technical staff and pointed out the dangers of inaccurate instruments and methods in testing and inspection. A progress report from E. M. Keeley, Crew-Levick Company, chairman of the committee on cloud-fluidity-pour and cold test was read by Mr. Scott. E. E. Bown, chief chemist, Emery Manufacturing Company, Bradford, Pennsylvania, presented a discussion relating to "Volatility and Distillation of Motor Oils."

Dr. R. P. Anderson, technologist of the American Petroleum Institute, reviewed "Fundamental Research in Petroleum," explaining that which has taken place in the realm of pure and applied science and referred to many applications that have been made of pure scientific discoveries. He discussed the 37 projects of research now under way under the direction of the A. P. I. "In the not far distant future," said Dr. Anderson, "it will be as popular to investigate the chemistry of petroleum as it has been for many years to study the chemistry of coal tar."

R. L. Wotowitch, Cities Service Company, trustee in charge of welfare and insurance, presided at one session, which was devoted to discussions of the work of the Safety and Fire Marshal's Association. A demonstration of first aid work was included. More than 200 men have been instructed in first aid work in the Pennsylvania refineries this spring. James H. Herbert, president of the Safety and Fire Marshals Association, reported on the work that these men are doing. Frank G. Benedict of the Sinclair Refining Company presented an interesting paper under the title of "Fire Prevention" and related specific warnings against practices that may lead to fire or accident.

One session, presided over by P. S. Tarbox, Independent Refining Company, trustee in charge of the department of manufacture, was purely a refinery operating methods session. H. A. Ross, engineer in charge of the joint work of combustion improvement of the association presented a paper, "Economy in Efficient Combustion." "The Advantage and Opportunity of the Small Refinery" was the title of a paper by H. S. Bell, consulting engineer, New York, which was read by O. P. Keeney, in Mr. Bell's absence. "Pipe Stills and Fractionating Towers" were discussed by A. Mullhaupt, Jr., Kendall Refining Company. Dr. E. D. Ries, director of research, Pennsylvania State College, invited refiners to seek the help of the university on research problems. "Filter House Problems" was the subject of a paper presented by Harry R. Lewis, Conewango Refining Company. H. P. Rue, associate refinery engineer, Bartlesville station, Bureau of Mines, read a paper on results of fractionation on the chemical treatment of cracked gasoline.

Trell Yocum, head of the department of public relations of the American Petroleum Institute, discussed the work of the institute being conducted to educate the public as to the facts pertaining to the petroleum industry. A resolution offered by O. P. Keeney, recommended to the board of trustees of the association, the endorsement of the publicity work of the American Petroleum Institute.

G. C. Davidson, Tri-State Refining Company, Kenova, West Virginia, presented an interesting economic discussion under the title of "Is the Refining Branch of the Industry Helpless in the Present Situation?" stressing the fact that the remedy for the situation lies entirely within the refiners' own hands.

J. E. Johnson, Waverly Oil Works, Pittsburgh, aroused considerable interest in cost accounting through the presentation of his paper "Determination of Manufacturing Expense" giving the forms used by his own company for refinery and grease plant accounting.

SPRING MEETING OF EASTERN REFINERS

Is the Refining Branch of the Industry Helpless In the Present Situation?

Address by G. C. DAVISON
Tri-State Refining Company

Before Semi-Annual Meeting of the National Petroleum Association, Cambridge Springs, Pa., April 19, 1928

JUDGING by comments of some men in the refining industry, and by the earning statements for 1927 which have been recently published, the refining industry is far from happy and prosperous. But before answering the question contained in the title of this paper, "is it helpless," it would be advisable to attempt to make a diagnosis of the case.

The refining branch of the industry seems to be suffering from the action of natural laws, aggravated by conditions now existing in its allied branches, production of crude, and marketing of refined products.

The first natural law that has played an important part in bringing about present conditions, is the law of diminishing returns. This law is very old, and fundamental, and applies to practically all industries. It means that when an industry shows a very great margin of profit, capital and ambitious individuals are attracted to it. The supply is increased, and competition reduces profits. When profits are reduced to a certain point for the industry as a whole, there will be some plants operating at a loss, so that one by one, they shut down, and in a measure help relieve the situation.

This law has been working in a very striking manner in the petroleum refining business for the past seven or eight years. Returns on investments have been diminishing, as shown by earning statements. A rough measure of these diminishing returns is shown by the narrowing margin between tank car price of gasoline and price of crude oil.

The operation of this law can be stopped by a monopoly, such as the manufacture of articles protected by patents, or by a rapidly increasing demand equal to or in excess of supply.

While the refining branch of the industry, like all industries, is subject to the workings of this law, it can adapt itself to it, and by an intelligent course of action always realize a fair profit, even if the enormous margins of seven or eight years ago have disappeared forever.

The second natural law which is furnishing the refining industry, is that of supply and demand.

Flooding Not Necessary

You are all so familiar with present conditions in the production of crude oil I will not go into that, except to remark that crude production and refining are so closely related that many seem to believe that when we have a flood of crude oil, that the market is inevitably flooded with low priced, unprofitable gasoline. There is no question about such having been the fact during the past year. But as to whether it is inevitable, or necessary, is another question.

Other industries furnish us with examples of how these two natural laws operate, and how an industry can, after having severely suffered, save itself. A fairly parallel case is that of the sugar industry. Sugar is a world commodity, like petroleum. Because of the world war, European beet sugar production was reduced to aboue one-fourth of normal. Sugar went to unheard of prices in 1920. Millions of capital went into Cuba. The production of that island was more than doubled. In the meantime, Europe increased its acreage. So for several years we have had an overproduction of raw sugar. Cuba was forced to sell at two cents per pound when the cost of production was nearer 3 cents. To correct the situation the Cuban government took a hand, and deliberately cut the production. Last year with a supply of cane sufficient to produce 6,000,000 tons of raw sugar, the mills were permitted to grind only 4,500,000.

This year Cuba has ordered its mills to produce only 4,000,000 tons, though the acreage planted is capable of producing a much larger amount. It was either a case of rationalizing production or seeing the price drop even below two cents. Cuba has conducted negotiations with other countries with a view to co-operation, to rationalize production.

It is too early to forecast just how this movement will turn out. In any case, it is interesting, and the petroleum industry should watch it in the event that it may some day have to take similar action. So much for the raw material, corresponding to our crude oil.

Concurrently with the overproduction and unprofitable prices, the sugar refineries of this country were in a demoralized state. Some of them, like some of the oil companies, had their own production. They were fighting each other for business, making secret concessions, and breaking every law of good trade practice until they reached a point where something had to be done about it. Our own refining branch seems to be rapidly following in their footsteps.

To correct this deplorable condition, the sugar refiners a few months ago organized the Sugar Institute. Certain bad practices were done away with. Thus far they have not artificially boosted the price of their refined product. But they have stabilized the market, have cut out unethical practices, and from all appearances conditions in the sugar refining industry have been greatly improved.

The copper industry is another example. The parallel is not quite so close as in the case of the sugar producing and refining industries, but it has been shown what can be accomplished by co-operation, by the rationalization of production, and the stabilization of prices.

Other examples could be mentioned. If we look on labor as a commodity, subject to the law of supply and demand, the labor union in a broad sense can be regarded as an organization to stabilize price, though it can not rationalize supply.

Supply and Price

One other industry that furnishes a splendid example of the working of the law of supply and demand is raw cotton. Here is a world commodity of which the United States produces the greater part of the world's supply. It has a real market, with exchanges in New York, New Orleans, Liverpool and other centers actively trading every working day in the year. Looking back over a period of many years, considering size of crop and prices, one sees almost a perfect example of the free working of the law of supply and demand. Some years we grow a bumper crop, exceeding by several million bales expectations based on average yields. The inevitable result is a drop in price, often far below cost of production. Again, due to freakish weather conditions or depredations of the boll weevil, or both, the crop falls short of average expectations, or normal requirements, and we see prices soar. This market has shown that cost of production has little or nothing to do with price. If the supply is greater than needed, price often goes far below cost of production, and conversely, if the supply is short, the price can go to double the cost. Paradoxical as it may seem, the South is usually more prosperous and gets more for its cotton when it has a bad year and raises a small crop than in the good years when it raises

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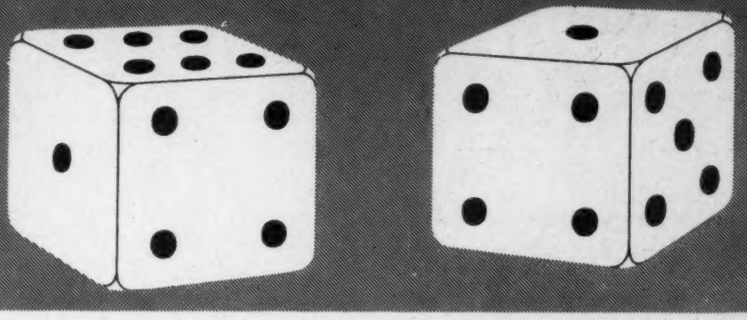

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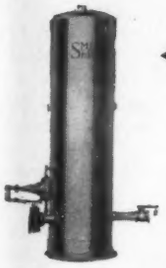

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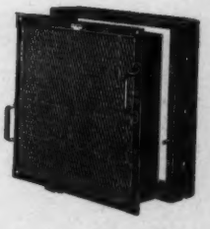

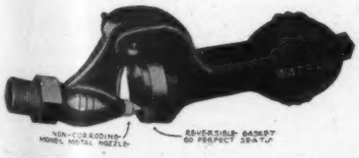

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SPRING MEETING OF EASTERN REFINERS

a big crop. The South so fully understands the situation that it, through banks, State governments, and associations, manages to roughly rationalize supply and demand by increasing or decreasing acreage from year to year as the market and world demand require.

When such an industry, made up of many thousands of little planters and big planters, subject to the vagaries of weather and insects, finds it possible to roughly adjust supply to demand, how much simpler is the problem of the petroleum refiner.

Out of curiosity, I looked up the size of crops and prices, covering a long period of years, and reduced them to a common denomination, calling normal world's consumption 100 per cent. —and therefore normal supply 100 per cent. For price I used cost of production as 100 per cent., as costs vary from year to year with the price of the dollar. Then by expressing departure from these bases in percentage, it is possible to plot relations between costs, prices, supply, and demand over a long period of years.

With cotton, price goes up rapidly with a shortage of supply. When the supply is 10 per cent. below normal the price averages about 15 per cent. above normal.

When the supply is in excess of normal, price does not fall so rapidly. When supply is 10 per cent. above normal, price is 10 per cent. below normal.

When supply is excessively above normal, price falls to about 65 per cent. of normal or cost of production.

There is, of course, a point below which price will not apparently drop, regardless of amount of supply. For cotton this is apparently about two-thirds' cost of production. The low point in price of sugar during the past seven years also happens to have been about two-thirds' cost of production.

If we knew the cost of production of crude oil, we would probably find that on the average, present prices are somewhere about this proportion.

This study of cotton tells the story of one big industry, and is probably applicable in a general way to others, including petroleum refining. If so, it should serve as a warning, as showing the possibilities of overproduction and consequent low prices. Thus if the cost of producing gasoline in the Mid-Continent area is now six cents, it would be possible to have the price go as low as four cents with unlimited overproduction.

Growing Demand

The petroleum refining industry is relatively fortunate. It has a steadily growing demand for its products, and a market created for it at no cost to itself. It can have perfect control of its output without making any great sacrifices. While we hear much complaint about the present situation, it is very mild compared with what other industries have experienced. We have seen what steps other industries have had to take to save themselves. So, profiting from their experience and example, it should not be difficult for the refining branch to regulate its output in accordance with the demand, and obtain for its products a price showing a fair profit.

In fact, even without an association embracing the entire refining industry, there are signs that heed has been taken, and a more sensible policy is being pursued. But if attention were paid to refinery statistics, and a common sense policy tacitly adopted, with a sense of fair play, the refining branch of the industry would have little to worry about. At the same time the public would have no cause to complain, as a stabilization of profit within moderate bounds would be the best safeguard for the future that the public could have.

There is also a modern law of business that seems to be recognized more and more. That is the law of service. Today the refining branch has an unusual opportunity to give real service in a big way, and I believe would do so if it could only get together and adopt a few general policies. This great opportunity for real service is along the lines of conservation. We have today above ground over 600,000,000 barrels of oil. Crude is being produced faster than required. Yet no one knows what our total reserve supplies under ground may be. While West Texas is now flooding the market, one eminent geologist has gone on record as predicting a total recovery of only one billion barrels from that entire area. The greatest estimate is only three billion barrels. While a billion barrels is a lot of oil, it is after all only a little more than one year's supply at current rate of consumption. So perhaps, after all, these recent discoveries have added only two or three years to previously estimated supply. Where the refining industry could render a great public service in the present situation is:

1. Shut down cracking plants or run them part time, and skim crude sufficient to meet present demand for gasoline, thus preventing evaporation loss of crude in storage. It could store the resultant fuel oil as cracking stock without loss from evaporation.

2. As soon as crude in storage has been reduced, use more fuel and gas oil for cracking, leaving crude underground where it will not evaporate.

3. Instead of forcing fuel oil on the market, get all the gasoline possible out of it by cracking.

4. Those big companies in a position to do so, to acquire a reserve production of crude, by buying up proven territory, and not drilling it until the crude is needed.

This policy would practically double the ultimate supply of gasoline, as compared with present methods. The public would be assured of more stable prices, and an adequate supply of motor gasoline for many years to come. And in the meantime the refining industry could enjoy a fair profit for an equally long period.

Of course such a policy as this can not be carried out under present conditions, where there is no general association and no co-operation. But in view of what other industries have already accomplished, and with such a wonderful opportunity to so easily perform such a great national service, it is earnestly hoped that the leaders of this great industry will find some way to get all the 318 plants to co-operate along some such lines, and to do so with the full approval of the government and the public.

The other alternative is to go ahead blindly, overproducing, each unit thinking only of itself, and developing cut-throat competition, which will virtually wipe out all profits. We seem to be drawing near to such a condition. It is to be hoped that before disaster overtakes the industry steps will be taken to produce and market in a rational manner, as so many other modern industries have done. As I understand it, it is only unreasonable combinations in restraint of trade that are illegal and frowned upon. It is due to the fact that the oil business has been the target of demagogues for so many years, and has been investigated so many times, that its leaders lean over backward, and have deliberately refrained from taking any steps to prevent ruinous and wasteful cut-throat competition. If so, it is hoped their legal departments will look into what other industries have done and are now doing, apparently with the approval of the government, and in the long run in the best interests both of the public and of the industry.

Going back to the title of this paper, "No, the industry is not helpless in the present situation."

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SPRING MEETING OF EASTERN REFINERS

Economy in Efficient Combustion

Address by H. A. ROSS
Combustion Engineer, National Petroleum Assoiation

Before Semi-Annual Meeting of the National Petroleum Association, Cambridge Springs, Pa., April 19, 1928

JUST a few months less than three years ago, I received a commission to make a survey of the heat producing situation in a small refinery located near Warren, Pennsylvania, emphasis being laid upon the fact that my attention to the boiler situation particularly, was desired.

For years previous to this time I had been actively employed in the design, construction and management of large power and other related heat producing and consuming equipment, so that I felt myself fully capable of affording the client a first-class report in this particular assignment.

Equipped with the regulation implements of a combustion engineer such as a pyrometer, flue-gas analyzer, slide rule, note book, brand new suit of overalls, plug of tobacco, and last but not least, one hundred per cent too much of self assurance which I was not long in finding out was not worth a "tinker's dam," I eventually arrived at my destination, "The boiler house in question."

I might interject the information here that no one saw me enter the plant, but after a few days' visit, there were a number of individuals on hand to speed my exit, and it wasn't "God speed," either.

My investigations had not proceeded very far before I learned that heavy fuel loss was a daily and continuing occurrence; fuel beds were open and full of holes admitting heavy volumes of excess air; firing routine was irregular; the mechanical equipment was in poor condition; steam lines were uncovered, and heavy waste of steam from leaking connections was occurring throughout the entire plant. Knowledge of even the rudiments of heat production or its conservation was entirely lacking and no one seemed to know what it was all about, from the manager down to the ash wheeler.

As I recall them, my reactions to the situation were such that I felt I could whip things into some semblance of order within a very few days. This brilliant idea of mine was probably inspired by the fact that I had handled heat problems in a fairly large way for a number of years, and therefore naturally felt that it was purely a matter of mechanical correction and re-adjustment. Not so many days were required to force me to a reversal of opinion.

During the latter months of 1925 and the early ones of 1926, I received a number of similar assignments for other refineries, and with but one exception, found every one of them almost identical in every particular with the first one. Boilers in many instances were old, their capacities seemed to be inadequate to satisfy the refinery demand, and although the firemen seemed to be working hard enough, steam pressure could not be maintained. As a consequence refinery production was curtailed.

Note that one exception was found. In this particular refinery everyone was on their toes! They knew what they were doing and a high standard of efficiency was being maintained. As a side-light, it is interesting to note in this particular case that in our two years of service afforded this refinery, the total savings obtained for them has been proportionately less than in any other refinery under our control. The reason for such a situation is obvious. We are today still retained by this company in order to periodically check their efficiencies and afford them an assurance against uneconomic power plant procedure.

During the first six months of my activities, which represented the period between the association's fall meeting of 1925 and the spring meeting of 1926, 12 refineries had been surveyed and an analysis of their heat producing equipment undertaken.

Personal Opinion Resistance

In each case a report of our conclusions and recommendations was submitted to the management or owners. In addition to this report, considerable time was spent in an effort to instruct the boiler operatives in the rudiments of economic firing procedure. Right here was found the "Ethiopian gentleman of the coal pile," in that intangible but nevertheless familiar guise of "Personal opinion resistance" afforded by management, superintendent, and worker alike. Probably the manager's reaction to our efforts in his behalf was a bit more polite than the fireman's, who invited us to go to that particular H—l assigned to all efficiency men, where the combustion engineer specifically could wreck his "satanic begotten" mysteries without let or hindrance, to his heart's content. In either case the results we obtained were identical, in that they were almost, if not absolutely, negligible.

The outstanding fact which developed during the first six months of our pioneer heat efficiency effort was, that in order to make our own recommendations and instructions effective in any fuel saving campaign, it would be very necessary to maintain a constant personal contact by some system or plan of follow and checking up conducted at regular monthly intervals at least.

The manufacturing committee made such a recommendation to the trustees at the 1926 association spring meeting, and on May 1 of the same year a co-operative plan, in which a number of refineries participated, was inaugurated. This was purely an experiment, and was to continue for the balance of that year.

In such fashion was this scheme of a co-operative combustion program conceived and born. H. S. Bell, consulting engineer, New York City, was selected as the administrator of the plan, and your speaker of the moment as the active field engineer.

Much to the surprise of a number of his former firemen acquaintances, who had in all probability forgotten him during the interim, your engineer again entered the boiler room picture. This time he was invested with the authority of management that was willing even to the point of anxiety to undertake the experiment, for business was not so good now. Our activities were, however, restricted within the definite limits of the boiler room and steam distribution systems.

During the previously mentioned first six months of our effort, one very important lesson had been most severely learned. This was that an arbitrary technical attitude on the part of the engineer toward the boiler operatives would never produce the results we hoped for.

In the refineries under control of the cooperative plan there was probably 100 boiler furnaces and 100 still furnaces, making a total in all of 200 heat producing machines. It was a fairly simple problem to operate these heat machines efficiently within the limits of their mechanical condition and arrangement, so as to obtain some fuel economy at least. When it came to controlling the human machine that operated the heat machine, an entirely different situation existed. Here was probably 200 human machines—each one having its own peculiar behavior —the efforts of whom it was absolute-

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ly essential to control in order to attain efficient combustion conditions and assure success.

There was no question at all about their ability to heave coal, but the mental process that motivated the physical act of heaving was another story. This was, still is, and will continue to be the one big factor in combustion economic problems.

After a few days of serious consideration given to a review of the experiences we had already encountered in the human resistance of the boiler room, it was felt that as a prelude to the main business of fuel saving, some simple experiments in psychology might be of considerable assistance, rather than a strict insistence upon the technique of proper firing.

Psychology of Suggestion

Perhaps some of you may think this is a far fetched or ridiculous idea, but I want to emphatically state that it has not only merit but value also, and I purpose to give you figures presently that will prove the fact. May I also respectfully suggest at this time and in this connection that if the same amount of effort frequently spent in riding a man ragged for some slight mistake or error of judgment was applied in a psychological manner, this time so spent would produce far more profitable results in the long run.

The experiment we made is called the "Psychology of Suggestion," and was conducted in the following simple manner: It was suggested that heaving coal was a laborious job and that a fellow was a damned fool to handle one pound more than he had to during his eight-hour trick. Suppose he had five boilers to fire and used only 75 pounds too much coal per boiler per hour. Under such procedure, in one month's time he will have shoveled almost a carload more than was necessary. Think of the labor required for a fellow to unload a car of coal himself, but this is what it practically amounts to if he fires only five shovelsful too many per boiler per hour. And you to whom I am speaking and who pay the bill, think of the total loss to you per month when we multiply this one hour loss of five shovelsful, or 75 pounds per boiler per hour, by the 720 hours per month. Under such uneconomic conditions the fuel loss per boiler per month is 54,000 pounds. Multiply this amount again by the number of boilers, plus the stills, in your plant and you have a heavy total preventable loss. Note that I used a factor of only five shovels. I have seen numbers of instances where 10, 15 and 20 too many, per boiler or still hour, were used. If you are so inclined, again use the aforesaid 54,000 pounds loss on a five-shovel basis and multiply by two, three, or four, as you may wish, and note the possibility of total loss which you incur.

Another "suggestion" was that there were thousands of men who could use a shovel to handle coal or other bulky materials and do a satisfactory job, but no artistry was required for the reason that it was a purely physical act. When it came to stoking a boiler, however, emphasis was laid upon the fact that it was not a problem of moving so much material in a given time, but rather a problem of producing the greatest amount of energy with the least material moved, and herein was an art, or the difference between skill and labor. This argument usually afforded the fireman an inspiration to ask questions, for the urge to excel is a common human trait inherent in all of us, and he is no different from the rest. When a man asks questions he displays interest, and when interest is aroused 50 per cent of the battle is won, for opportunity to sell the idea is at once afforded.

These illustrations I have used are only two of many others, similar in character. In every case, however, the effort was directed toward increasing the individual's self-respect by means of the psychology that he excelled the other fellow because he was better informed and therefore a better workman, which in very fact is the truth.

So much for the hand fired equipment. Tactics similar in substance but different in application were followed in the automatic stoker equipped plants. Time, however, will not permit an elaboration of this phase of the work.

Coincident with our adventure in psychology we established a system of office records as a check-up on economic performance. These in turn were transferred to graphic form, and comparative curves in duplicate were made. This alone has entailed a heavy amount of office work, but we are well repaid for the effort in the information we obtain. I might mention in passing that each refinery has copies of all the data we produce.

The essence of all that I have said has so far been more or less abstract in value. I now present some concrete values for your consideration. First, however, I want to say that the savings claimed have not been attained entirely by improving combustion conditions nor by my personal efforts alone; these are only contributory to the total effect.

Too much emphasis cannot be given the importance of the managing and operating executive's assistance. Their cooperation alone has afforded the means of accomplishment, and I would not have you understand it otherwise. We only made the suggestions, they did the performing.

In 1925 fifteen refineries processed 2,756,672 barrels of crude.

In 1926 they processed 3,053,798 barrels of crude.

In 1927 they processed 3,429,288 barrels of crude.

Average per refinery in 1925 is 183,788 barrels.

Average per refinery in 1926 is 203,586 barrels.

Average per refinery in 1927 is 228,619 barrels.

Thus the crude run in 1926 over 1925 increased nearly 11 per cent. The increase in 1927 over 1926 was nearly 12.5 per cent, and the increase in 1927 over 1925 was over 24 per cent.

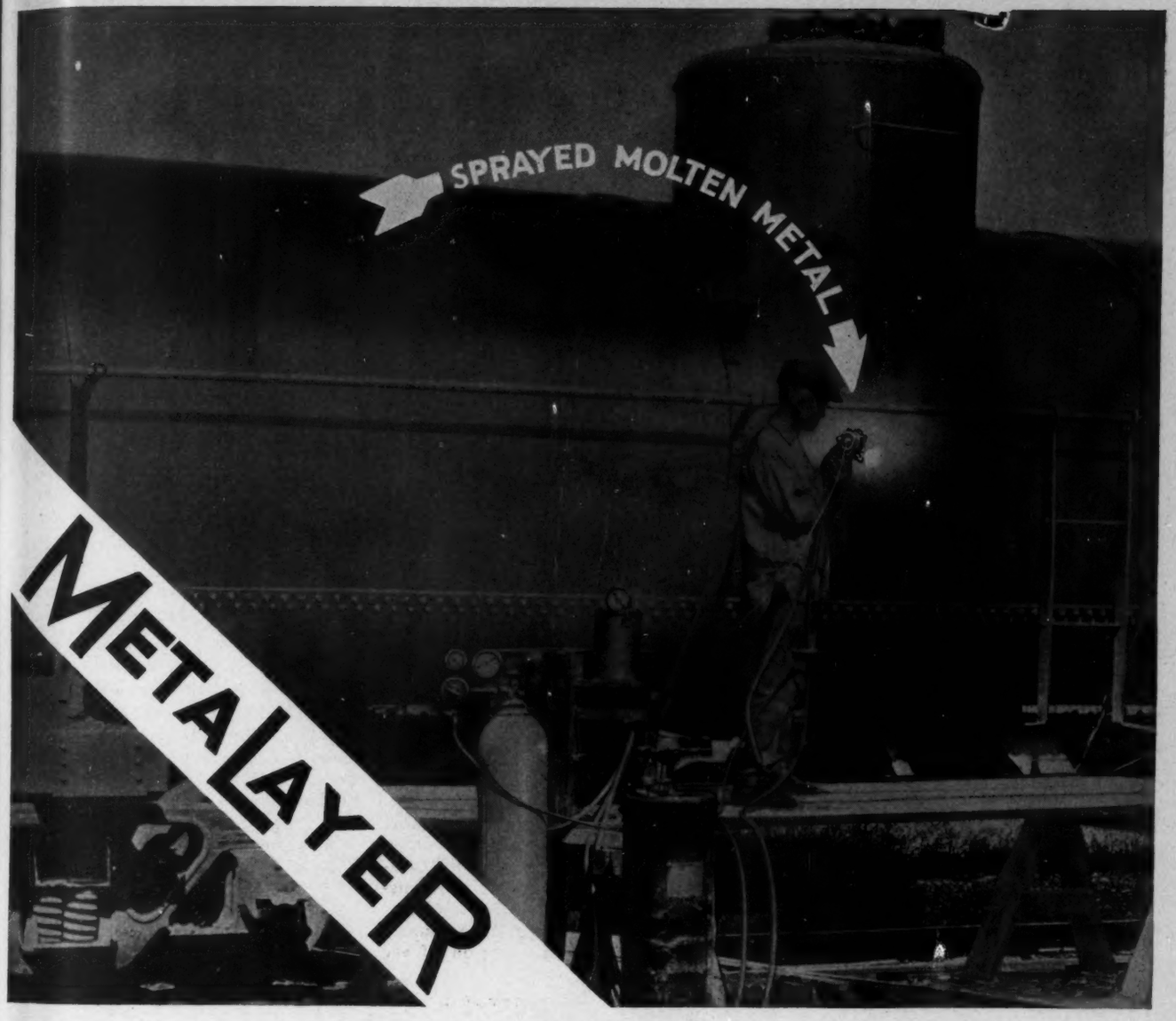
Value of Efficient Combustion

I would now like you to give particular attention to what follows, in order that I may prove to you the value of "Economy in Efficient Combustion."

It was just stated that still throughput of crude in 15 refineries had been increased 24 per cent in two years of operation. This increase was obtained with the same old equipment of shell or cheese-box stills in every refinery with but one or two exceptions. In these particular installations, new crude fractionating equipment has only been operated for a few months during the latter part of 1927, so that their effect upon the total runs is negligible. Naturally, such an increase of crude throughput automatically would also require more re-running and filtering and a much greater quantity of steam than formerly. Undoubtedly it does, but in no case has additional boiler capacity been installed. One exception is noted, where two new boilers of 400 horsepower capacity were installed last September to replace three condemned units.

This increase in throughput has been obtained with the same old power plants. Many of the boilers were so old that serious consideration was given the advisibility of new installations. Some of this equipment must soon be replaced, but the point is, old boiler equipment, like the stills, has been given a new lease of productive life, and at the same time has been made to afford much greater quantities of product.

Another very interesting fact in connection with the steam producing equipment is this: Whereas formerly, at times it was almost an impossibility to supply the refinery demand for steam with all of the boilers in operation and consumnig coal at a tremendous rate, today we have refineries where half of the boilers are absolutely out of service and are not operated at all. Again we have others where



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for hours at a time one or more of the boilers are under banked fires awaiting a peak load. In every case, however, each of these refineries is producing its proportional share of this 24.5 per cent increase in production.

Decreased Coal Consumption

Previous to 1926 many refinery records of coal and crude purchased were more or less incomplete, and it was found to be a difficult matter to go through old files to obtain the correct figures. However, out of a total of 22 it was possible to obtain records of 15 for 1925.

I shall not weary you or occupy your time with a mass of figures and statistics, but at the same time there are a few very interesting comparisons to which I should like to call your attention, so that you may have some idea as to how much the consumption of coal has been reduced in two years, using as a basis for the comparison the average pounds of coal burned per barrel of crude in the previously mentioned refineries.

In 1925 this consumption of coal was 196.5 pounds per barrel. During the year of 1926 the consumption was actually reduced to 148.5 per barrel, thereby affording a saving of 50 pounds per barrel. This is equivalent to 25.4 per cent. In 1927 this consumption was further reduced to 137 pounds per barrel, making the reduction for this year 59.5 pounds less than in 1925, or an equivalent of 30 per cent. Thus in two years of effort, despite the fact that nearly 25 per cent more crude was run through the refineries, the coal consumption per barrel has been reduced 30 per cent. Resolving these figures for the two years to a tonnage basis on the amount of crude run for the same period, it is found that 76,344 tons of coal was saved in 1926 and 102,277 tons was saved in 1927, the total amount saved for the two years being 178,621 tons.

Now do not be misled by any false assumption that the correction of poor firing procedure alone afforded these savings. In the majority of cases we still have the same old heat producing equipment as when we started.

In the earlier days of the industry when profits were easily attained no one gave much consideration to fuel economy. As a matter of fact the subject efficient fuel consumption was practically a closed book, for oil, coal, and gas fuels were so extremely cheap that they amounted to but little in the total set-up of manufacturing cost. Today fuel alone amounts to anywhere from 20 to 30 per cent of such cost, and is a factor of much importance—but we still have the hangover of the poorly designed furnaces that were originally erected. Obviously, then, our combustion activities are limited, and while much improvement has, and still will be made, pending the installation of efficient equipment, the engineer will fail of his economic mission if he does not take a full advantage of the many other opportunities afforded him in a conservation of the heat produced.

Adventure in this particular of heat conservation will lead him afar from the science of combustion. Perhaps his enthusiasm for the welfare of the little B.T.U. he has so carefully reared may lead him afoul of the petroleum technologist, the purchasing agent or the stillman. Mayhap he will shed the "combustion chrysallis" and develop into a beautiful full-fledged petroleum butterfly, winging his way to other heights of economic glory! Who knows?

Returning again to the seriousness of the situation. The combustion engineer in order to successfully accomplish his economic purpose will be required to practice a full measure of the psychology I have mentioned in all of his activities, for it is my honest belief that this procedure on the part of your engineer has been the greatest contribution to the savings we have stated.

Just a concluding word in a further exposition of the value of psychology in the refinery. There are men within the sound of my voice who are today successfully applying it, but their extreme modesty forbids my use of their names at this time. It would, however, afford me great pleasure to privately introduce them, should you so desire.

I have also transgressed, if you choose to call it such, in that I have sincerely endeavored, by means of "The psychology of suggestion" to prove the value of "Economy in Efficient Combustion" to you.

Fire Prevention

Address by FRANK G. BENEDICT
Insurance Engineer, Sinclair Consolidated Oil Corporation

Before Semi-Annual Meeting of the National Petroleum Association, Cambridge Springs, Pa., April 19, 1928

FIRE prevention is all too frequently looked upon by those who have not had occasion to give it serious thought, as something that is complicated, technical and theoretical, and as something that is advocated largely for the benefit of the insurance companies. As a result, in many cases, it has been practiced spasmodically and half-heartedly; hence its substantial benefits have not been generally recognized. As a matter of fact, however, fire prevention is little or none of the foregoing, but is largely the application of ordinary common sense, and, in reality, as applied to industry, effective fire prevention consists almost entirely of the education of the personnel, from the president right down the line to, and including, the day laborer or most unimportant plant employee. For this reason the usual fire prevention campaign of a few days' or a week's duration, while it may, and probably does prevent some fires, merely scratches the surface, and is not efficient, in that it does not make our plants and refineries as fire-safe—every day in the year—as it is possible to make them from a practical standpoint. To be 100 per cent effective, fire prevention must be practiced day in and day out, and year in and year out, and the lessons must be learned and become second nature to each individual.

Effective fire prevention does not mean anything drastic or revolutionary. It is seldom necessary that any large sums of money be expended, or is it necessary that our plants be remodeled or rebuilt along expensive lines, or lines impractical from an operating standpoint. Our plants and refineries can be made reasonably fire-safe, as they now are, simply by means of education, the fundamentals of which are:

First—The lesson that all fires are unprofitable and wasteful. Unprofitable both to the owners and the employees, and wasteful as regards the public. The matter of whether the property is insured or not, should be forgotten; insurance has never yet repaid all of a fire loss, and in fact it is impossible to buy insurance that will

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pay all of the losses suffered. Insurance may compensate, but it will not bring back customers and business or jobs that are lost; it will not bring the dead to life nor will it replace destroyed products. A fire means an interruption of business and the resultant monetary losses; it means the loss of jobs to those employed, and the resultant loss to them of wages. The destruction of a plant can be a very serious calamity to the inhabitants of the community which has grown up around it and who depend upon it for their livelihood. A fire to the owners may mean only a loss of property, but to the employees it may mean want, suffering, or even death. Also it is coming to be more and more known and recognized that a fire is wasteful, that irreplaceable resources are destroyed, and so a fire is actually an affront or injury to the public at large. A barrel of oil is a natural resource and when it is destroyed in a fire it can never be replaced, and the world is poorer by one barrel of oil.

Second—The lesson that probably 80 per cent of all fires originate either directly or indirectly in some act of carelessness. Carelessness can be eliminated, and it must be eliminated, if fires are to be prevented. A careful workman is not only protecting the property of his employer, but he is also protecting his own life and livelihood and those of his fellow workmen. A careless workman is a menace to the whole community and should be treated as such.

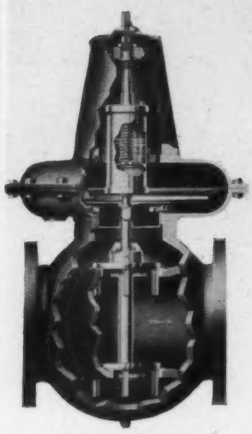
There are many and various kinds of carelessness that may contribute either directly or indirectly as fire causes. For example:—It was a careless employee who built a large hot fire in the heating boiler of a certain plant, and the failed to watch it. The over-heated stack ignited the wooden roof that a careless carpenter had not given sufficient clearance from the stack. The fire burned along the roof and over the brick side walls into adjacent portions of the building involving them in the fire because a careless architect had failed to specify that the side walls extend up through the roof. It was a careless owner who failed to supply his plant with adequate fire protection, and it was a careless workman who accidentally knocked an extinguisher over causing its discharge and failed to report it so that it could be promptly recharged. It was a careless plant superintendent who failed to organize his employees into fire crews or who failed to see that fire crews, when organized, were regularly trained along common sense lines. A fire occurred in a certain plant which had supposedly efficiently trained fire crews. The fire was in a small building in a remote portion of the plant. The fire crews arrived while the fire was yet small, but nobody knew where the hydrants were located. Valuable time was spent hunting for the nearest hydrant, with the result that the building was destroyed. The fire crews at this plant now vary the regular drill with the apparatus, by tours over the entire plant when the layout of the water system is studied and the locations of all fire protection appliances are impressed on them; also it is pointed out how certain hydrants and apparatus are strategically located with reference to certain units or buildings about the plant.

It was a careless top-man who pulled the manhole cover on a hot still instead of the one on a still which had been pumped out and was being steamed. It was a careless outside helper who thawed out a frozen open water draw-off valve in a hot tar line with a steam hose, while the still was being pumped out through this same tar line. It was a careless fireman who casually inspected the bottom of a coking still and failed to take note of a hot spot. It was a careless welder who burned a hole in a tank roof before the tank had been steamed, and it was a careless foreman who allowed that welder to start his operations before proper precautions had been taken and so on.

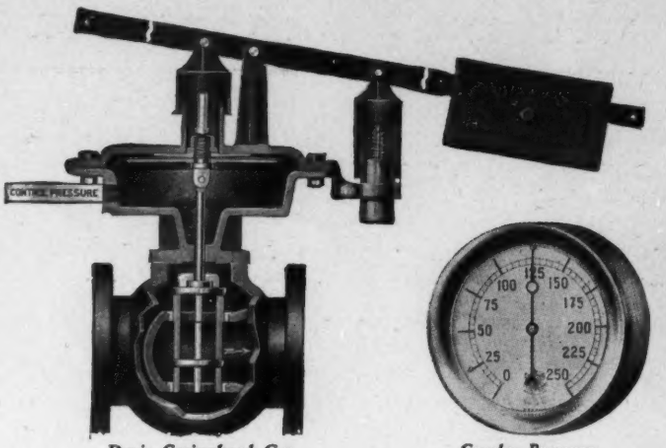
Third—The lesson that good housekeeping not only prevents fires but also pays dividends in other respects. The working conditions in a clean plant are better and the employees are not only more contented but also do better work, and put out better and more uniform products. A clean plant seldom has a fire, but when a fire does occur, it is much less liable to spread than in a dirty plant. Good housekeeping breeds careful workmen and with careful workmen on the job, a fire hasn't much chance to get started. Fires start in clothes lockers when they are used as catchalls or when the clothes in them are not kept properly hung up. Crammed full and seldom emptied waste cans frequently cause fires. Fires start in unswept corners and out-of-the-way places, and fires spread because of spilled oil not cleaned up and communicate to other buildings because of trash along railroad tracks or inflammable material carelessly deposited or piled on ramps or in area-ways. If the housekeeping in a certain boiler shop has been good, the spark which flew from a welding job could not have lit on some greasy rags on the floor and if there had not been a loose pile of broken crates nearby, which the heat of the burning rags ignited, this fire would not have spread. Again, if the spilled oil on the concrete pavement in front of a battery of stills had been cleaned up and washed into the sewer, the flash-back from a carelessly watched fire under one of the stills would have been of little moment, but the oil was there, it did ignite, and a disastrous fire ensued.

However, good housekeeping is much more than using a broom and emptying waste cans. Search, through frequent periodic inspections, for not only accumulated rubbish, waste, etc., but also for defective electric wiring, missing vapor-proof globes, leaking oil lines and tanks, defective vents, empty fire extinguishers, missing or defective hose and appurtenances, inoperative fire doors, openings in tank roofs that should be kept closed, followed by the prompt repair and correction, in every case, is good housekeeping. Good housekeeping is also the constant search for conditions and methods employed in operation which cause fires and many times can be changed without retarding or inconveniencing operations. Reporting to the boss any practice or condition which appears dangerous to an employee, is also good housekeeping. Honest and serious consideration, of this report, by the boss is also good housekeeping.

At this point, the questions may very properly be raised "How is fire prevention, along the foregoing lines, to be practiced efficiently?" "What is the use of repeatedly reporting all of these items of deficiencies to the plant superintendent, when there is nothing done about it?" Again, the answer here is education. Fire prevention is as much a matter for the entire management as it is for the rest of the organization. Efficient management readily sees the beneficial features of anything pertaining to the business and appreciates hearing of any defects in the business. Efficient management likes profits, but hates waste, and is anxious to prevent the interruption of planned manufacturing and selling programs. Education of the management will soon convince it that reasonable expenditures for the elimination of hazardous defects and other fire prevention measures is not an expense, but a good investment, and fire prevention seriously practiced, from the president down, will soon find everyone in the organization cheerfully doing his bit and will produce more days of full operation, per year, by making their plants fire-safe; and unconsciously, with increasing earnestness, the slogan—in act and thought—will be—Don't have fires.



Davis Super-Sensitive Relief Valve



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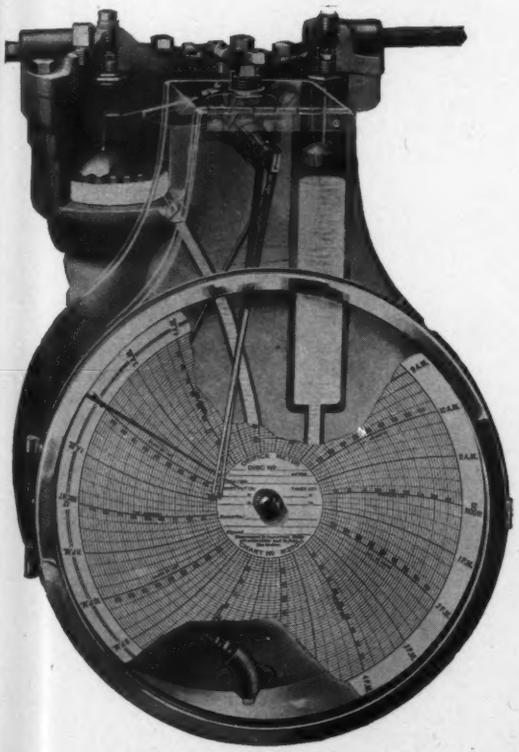

Westcott Orifice Meter

As specialists of long standing in providing measurement and control equipment for the Petroleum Industry, WESTCOTT & GREIS offer equipment suitable for accurate regulation at every point in the manufacture of natural gasoline.

The accuracy and general dependability of each item of this equipment is assured both by the carefully bestowed approval of the Westcott & Greis organization and by the name of a world famous maker.

WESTCOTT & GREIS also offer authentic technical information regarding the measurement and control of fluids, gas, air and steam. For this service we maintain a staff of experienced engineers and a well equipped mechanical laboratory at Tulsa. Patrons are invited to call on us for the solution of problems involving measurement and control of liquids and gases.

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MEASUREMENT AND CONTROL

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SPRING MEETING OF EASTERN REFINERS

Some Effects of Fractionation on the Chemical Treatment of Gasoline

By H. P. RUE[1]
Associate Refinery Engineer, U. S. Bureau of Mines

Before Semi-Annual Meeting of the National Petroleum Association, Cambridge Springs, Pa., April 20, 1928

MANUFACTURING and refining gasoline so that it will meet all the requirements of the motoring public is often a difficult and expensive process, especially when the gasoline is made wholly or in part from cracked or pressure still distillates. Nearly all of the gasoline made in the United States receives some kind of chemical treatment before it is sold to the public, the conventional method with cracked or synthetic gasolines being to treat the raw distillate with sulphuric acid and then with an alkali, and, if necessary, to re-distill with steam to the required distillation range. Many refiners have developed improvements in this process, and variations are necessary for treating some classes of distillate, but in general the acid-alkali treatment can still be considered standard practice.

During the last few years the refining industry has made great strides in the development of continuous equipment for the fractionation of the lighter products from petroleum. Bubble towers are used in many plants and more are being installed daily. The advantages of an effective continuous fractionation system in stabilizing the distillation range of the gasoline produced are generally realized, but I believe that little attention has been paid to the possibility of using this distillation equipment to reduce the amount of treating necessary and thus lower treating costs. My work with the Bureau of Mines during the past two years has been to investigate this possibility, and although the investigation is not complete, I believe that the results already obtained are well worth your consideration.

Removal of Impurities

There are several reasons for subjecting a gasoline to treatment before it is sold as motor fuel, the chief ones being to improve the color, to remove corrosive or evil-smelling sulphur compounds, and to remove the gum-forming constituents. The fundamental principle of the present investigation is that these various impurities are not distributed evenly through the boiling range of all gasolines, and in some cases at least they seem to predominate in certain fractions. By careful fractionation, for example, in a bubble tower, it is possible with some gasolines to concentrate each impurity in a small portion of the product so that these small portions are all that require chemical treatment, the greater part of the gasoline being ready to market as it leaves the condenser.

The possibilities of efficient fractionation on the treating of gasolines were first brought to our attention during another investigation in the bureau. A sample of cracked distillate was distilled, and a series of fractions with successively higher boiling ranges was made. The first few of these fractions were water white, while the higher-boiling ones were yellow. This set of fractions was distilled again, and more of the gasoline was recovered free from color, indicative that if a better method of fractionation were available it might be possible to obtain almost all of the gasoline in a water-white condition.

Experimental Equipment Used

A bubble tower can be used to advantage to fractionate gasoline into several portions, as streams can be drawn from different plates in addition to the product from the top of the tower. By careful study of the streams a control system can be applied to the tower so that the greater part of the product can be obtained in marketable condition, no further distillation or chemical treatment being necessary. Some of the streams may require one type of treatment, others another type, depending on the kind of impurities each contains. In the present investigation a semi-commercial 13-plate bubble tower was used. Pressure-still distillates and straight run naphthas of different types were charged into a pipe still at the rate of about 20 gallons per hour. The mixture of vapor and liquid coming from the pipe still was flashed in an evaporator and the vapor from the evaporator was passed into the bottom of the tower. Streams could be drawn from any desired plate in the liquid state and passed through cooling coils. Vapor from the top of the tower was passed through an appropriate condenser. Each of the distillates was in this way cut into several fractions and a thorough laboratory examination was made of each fraction.

Effects of Fractionation on Color

As was to be expected, it is comparatively easy to obtain most of the gasoline in a water-white condition. This does not mean that because a gasoline is water-white when first made it will remain so in storage or after being exposed to light. When operating on straight-run distillate from high-grade crude it was possible to take most of the product overhead as vapor, leaving practically all the colored compounds to be withdrawn from the side of the tower in the liquid state.

This fraction containing the coloring material could then be treated with acid and alkali and added to the overhead distillate to give a finished gasoline. When operating on pressure-still distillates it was found that the first 30 or 40 per cent of the gasoline would have good color and would be stable, but the rest of the product would require treatment for color. It is believed, however, that with a more efficient tower a much larger proportion of the product could be obtained with a very stable water-white color.

Effect of Fractionation of Sulphur Compounds

In our experiments on fractionation of pressure distillate by means of a bubble tower we found apparent segregation of the sulphur compounds, at least as far as the usual corrosion and doctor tests are concerned. With one pressure distillate which yielded about 70 per cent of 437 degree F. end-point gasoline, we found that the product coming off in the vapor phase was corrosive to the copper-strip test and doctor sour, and the product coming off in the liquid phase was non-corrosive and doctor sweet. If the total yield of gasoline was taken off in the vapor phase it was corrosive and doctor sour, but if we controlled the temperature in the tower so that we took off part of it in the liquid phase and part in the vapor phase and later combined these to get he total gasoline yield, we were able to get a non-corrosive, doctor sweet gasoline without chemical treatment. I might add also that the product formed by combining these two streams had a good color stability and after being exposed to direct sunlight for six months showed no drop in color.

With another pressure distillate we had somewhat the same experience. Both the vapor phase and liquid phase products were non-corrosive, but the vapor phase product was always doctor sour. This distillate gave about the same yield of 437 degrees F. end-point gasoline as the one mentioned above. By controlling the temperatures in the tower and the amount

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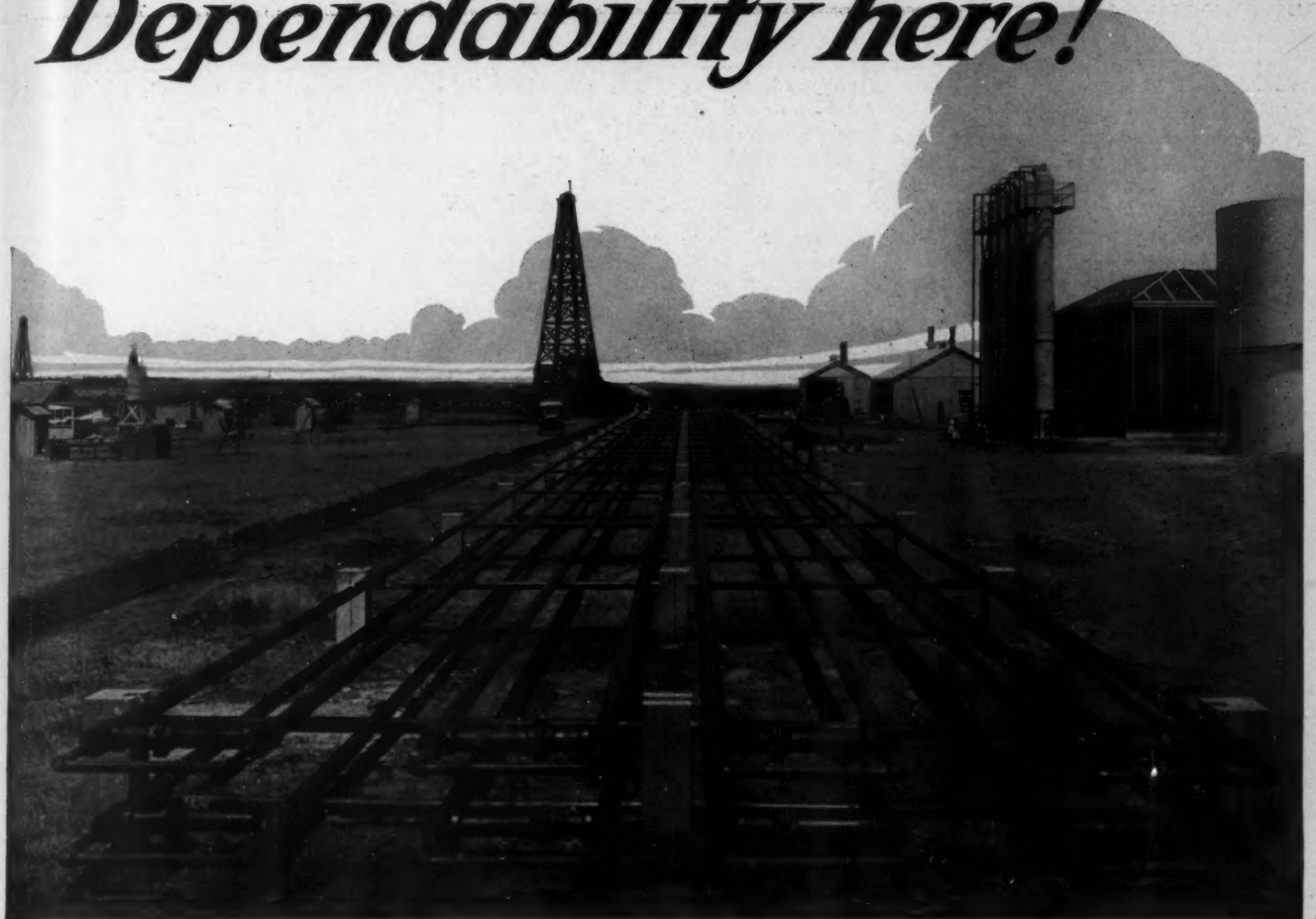

IN this heat exchanger built of "NATIONAL" Pipe, the hot oil runs between the 2-inch and the 4-inch pipe for the purpose of heating cold oil which runs through the 2-inch pipe. Expansion and contraction are factors for consideration here, as well as good tight joints—the result of clean, strong threads. Resistance to corrosion both inside and outside and clean, smooth walls which assist materially in reducing loss by friction, add importance to the selection of the proper pipe for such purposes.

The qualities of uniformity of material, great strength, durability, etc., which have made "NATIONAL" Products so much in demand in the producing field are also inherent in "NATIONAL" Pipe for refinery service. This is why it is so generally used by the larger refineries and recognized by them as the standard of wrought pipe for refinery purposes.

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SPRING MEETING OF EASTERN REFINERS

drawn off in the three different streams we were able to reduce or segregate the doctor sour portion to 8 per cent of the yield.

The effect of fractionation is also very pronounced in the treatment of straight run products from certain crudes. I have in mind one crude that yields gasoline which in general is very difficult to make doctor sweet. The portion of this gasoline that offers the greatest difficulty is in the heavy ends, I believe around the last 10 or 20 per cent of the 437 degrees F. end-point product. We have experimented with treating or sweetening the export and Navy grades of gasoline from this crude and found that the export grade can be treated much more easily than the Navy grade. If good fractionation is employed in distilling this gasoline from the crude its effect is very noticeable in the treating.

Effect of Fractionation on Gums

The work of fractionation gave some interesting points on the gum content of various fractions from cracked gasoline. The gum test as run in the laboratory (either copper-dish or steam-oven method) will usually show that the heavier the stream the greater the gum content, but this is not always true when the samples are allowed to stand in storage. We have found that certain fractions seem to contain a preponderance of the gum forming compounds. In one sample of pressure distillate that I have in mind, we found that the 30 or 40 per cent fraction formed on standing in storage many times the amount of gum in all the other fractions combined. The 10 to 20 per cent fractions did not contain any gum, even after standing exposed to direct sunlight for a year. It is not always the same fractions in different cracked gasolines that contain the greatest amount of gum-forming compounds, thus it is necessary for each refiner to study his own particular stock.

Refinery chemists generally assume that diolefins are the parent substances from which the gums are formed. Heat and pressure will cause these diolefins to polymerize to higher-boiling compounds which are usually considered gums. This being the case, it is not unreasonable to assume that gums may be formed during a distillation process, and if the fractionating device is effective enough these gums should be fractionated out of some of the cuts.

In connection with one of our runs in which three streams of light products were drawn from the tower we found some interesting relations in the gum contents of the different streams, as determined by the steam-oven method. When these three streams were drawn from the tower, it was found that the gum content of the middle stream was ordinarily greater than that of the other two streams combined, and by controlling the temperatures and the amount of each stream it was possible to vary the gum content at will. This must not be construed to mean that it was possible to eliminate the gums entirely, although in future it may be possible to do so. It does indicate, however, that polymerization does take place in a bubble tower and that it is possible to control this polymerization and to a certain extent segregate the polymerized products.

Losses in Treating with Sulphuric Acid

Treatment with sulphuric acid will remove some of the sulphur compounds and change the form of some of the others, but its effect on free sulphur may be considered negative. The acid will polymerize the diolefins to higher boiling hydrocarbons but at the same time it will also polymerize some of the olefins and thus cause excessive losses unless the conditions of temperature and time of contact are carefully controlled during the period of treating.

In treating pressure distillate with sulphuric acid before rerunning the greatest loss seems to be in the light ends. If the distillation curves for raw and treated pressure distillate are plotted on the same sheet it is usually noticeable that these curves will diverge greatly up to about the 30 per cent point and from there on to the end they will run parallel. The percentage difference of the two curves at this point (of greatest divergence) is an indication of the loss in the light ends. This however does not indicate the total loss as no doubt some of these light fractions are polymerized to higher boiling compounds which still fall within the gasoline distillation range.

In one gasoline studied the loss in the light ends was about 17 per cent while the total loss was 13 per cent which indicated that part of the light ends were polymerized to higher boiling compounds which still fell within the gasoline distillation range. This loss was the greatest that we found in our experiments with pressure distillate. I believe the average would be around 5 or 6 per cent.

If the temperature of the product during the time of treatment with acid is kept as low as possible and the time of contact is curtailed the losses may be reduced considerably.

Treating Products With Caustic or Soda Ash

Caustic soda is used as a neutralizing agent after acid treatment and also as a desulphurizing agent in combination with other compounds, such as litharge. A solution of caustic soda and litharge, known as "plumbite" or "doctor" solution, is used extensively in petroleum refining.

Aside from the conventional methods of applying alkali, very good results can often be obtained by washing the product as soon as it leaves the condenser with caustic or soda ash. Washing with caustic is much more effective if done at once than if the product is allowed to stand for a time before washing. It is especially so in the case of pressure distillate that has been acid treated before rerunning. In rerunning pressure distillate that has been acid-treated some of the esters will break up and liberate SO_2, which will attack some of the unsaturated compounds unless it is removed or neutralized at once.

At times good results may be obtained by washing with water alone. In some of our experiments we have found that it was as effective as steam distillation in improving the color of products.

Conclusions

Our work on the effect of fractionation on treating suggests that it is best to separate gasoline distillate into fractions, treating each according to its requirements.

As I stated in the beginning this work is not complete. In fact, I do not believe that it will ever be possible to give detailed directions for the best operation of fractionating equipment. Different crude oils apparently contain different amounts of impurities, and these impurities in turn vary greatly in boiling point. It is necessary therefore for each refiner to study the products made from the crude he is running and find out for himself just what parts of the gasoline require the different kinds of treatment. If this is done, I believe it is possible for any refiner to reduce very materially the volume of product which must be treated and this in turn will correspondingly reduce the cost of manufacturing gasoline.

Refrigerating Engineering in Petroleum Refineries

(Continued from page 76)

gas valve, the machine is again ready for operation. Care should be taken not to open the expansion valve too wide at first.

Table 4 shows ideal operating conditions that should exist in producing 0 degrees, 5 degrees, 10 degrees and 15 degrees F. brine from an exhaust-steam, ammonia-absorption type of refrigerating machine.

Figure 1 shows the general arrangement of a double-pipe, ammonia-absorption refrigerating machine.

Figure 2 shows a portion of the refrigerating room in the Sharples Dewaxing Plant at the Parco, Wyoming, refinery of Producers and Refiners Corporation. The ammonia-absorption system of refrigeration is used at this refinery.

Figure 3 shows the general lay-out of the essential refrigerating equipment used in this same refinery, and the steam and water lines used for pumps and refrigerating apparatus at this same plant.

Figure 4 is a chart that shows the amount of refrigeration produced under various brine temperature-differences and rates of pumping.

A REAL *Buyers' Guide* FOR YOU

THE JUNE issue of *The* REFINER AND NATURAL GASOLINE MANUFACTURER will be the annual Buyers' Guide Issue. But it is going to be vastly different from Buyers' Guide issues of the past.

This year, instead of promiscuous listing of equipment, the listings will be confined to items actually being pushed by the companies listing them. In the past there has been some complaint that items were listed which were not available from the companies listing them.

This objection is being removed through the manner in which the listings are being secured. Every care is being taken to prevent "dead items" from appearing in the Buyers' Guide.

Consequently, this year, the Buyers' Guide Issue should be of even greater value than it has been during the past three years that we have been publishing it.

It is our hope and desire that it be made as useful to refiners and natural gasoline plant men this year as possible. The work of compiling it is considerable. The work of classifying it, of indexing it, etc., represents a far greater amount of detail than one not familiar with it could appreciate.

When your June issue arrives and you have read the current matter in it we suggest that you reserve a special position in your files for this issue because of its permanent value.

The Refiner and Natural Gasoline Manufacturer

Vapor Recovery Plant Is Self Supporting

THE gasoline recovery system at the refinery of the Cushing Refining and Gasoline Company has recently been redesigned and rebuilt, with the result that a much larger gallonage of gasoline is secured from the light oil tank vapors and receiving house gases.

The vapor recovery plant was designed so that its operation does not necessitate any additional labor, but practically operates itself, with but occasional inspection. Through the use of scrap material for absorbers and tank, cost of the installation was very low.

The plant consists of one absorber, which was made of a 20-foot length of 20-inch casing, fabricated by the plant welder. Another joint of smaller casing is utilized as a scrubber or separator drum. The storage tank for gasoline is an old boiler shell.

A 8x10x8 Gardner compressor pulls a slight vacuum on the gasoline rundown tanks and the receiving house look boxes. The compressor boosts the vapors and gases to a pressure of 30 pounds per square inch. These vapors after compression are injected into the scrubber or separator device, where a small amount of gasoline, condensed moisture or impurities are accumulated. Leaving this small tower the gas is clean. It is then conducted to the bottom of the absorber tower, where it rises upward through baffles in counter current flow to circulated naphtha injected into the top of the tower.

The naphtha is circulated from the storage tank and through the absorber by means of a Gardner duplex pump, size 4½x3x4 inches. This was a spare pump no longer needed in its former capacity in the refinery, and while it is slightly larger than was necessary for the gasoline recovery system, good economy pointed to its service there is preference to the purchase of a new pump.

Through circulation from the storage tank to absorbers the naphtha is built up in gravity to around 58 to 59 A. P. I. gravity. Circulation is at the rate of approximately 1500 gallons of naphtha per day.

The compressed gas leaving the separator tank is cooled by passing through a series of two-inch coils before it enters the absorbers. These coils are cooled by water spray descending over them in just sufficient quantity to keep the pipes wet. The water accumulates in a pan beneath the coils and flows by gravity into a square cup and is conducted back to the water storage tanks. No separate water pump is required for the circulation of this cooling water, since a small line leads from the main water system conducting water over the refinery condenser boxes to this cooling coil. The volume of water going over the coils is regulated by opening or closing a valve at the head of the coil. This does away with the usual installation of an individual water circulating pump at the recovery plant.

In addition to the scrubbing action received in the absorber tower the gas receives a second scrubbing before it is returned to the stills for fuel. Gases leaving the top of the absorber are conducted to the naphtha storage tank, which is held under 25 pounds pressure. The gases are conducted to the bottom of the tank and released through a spider arrangement, from where they flow upward through the body of naphtha in the tank. The gases are conducted from the top of the storage tank through a two-inch line to a small upright drum which is partially filled with water.

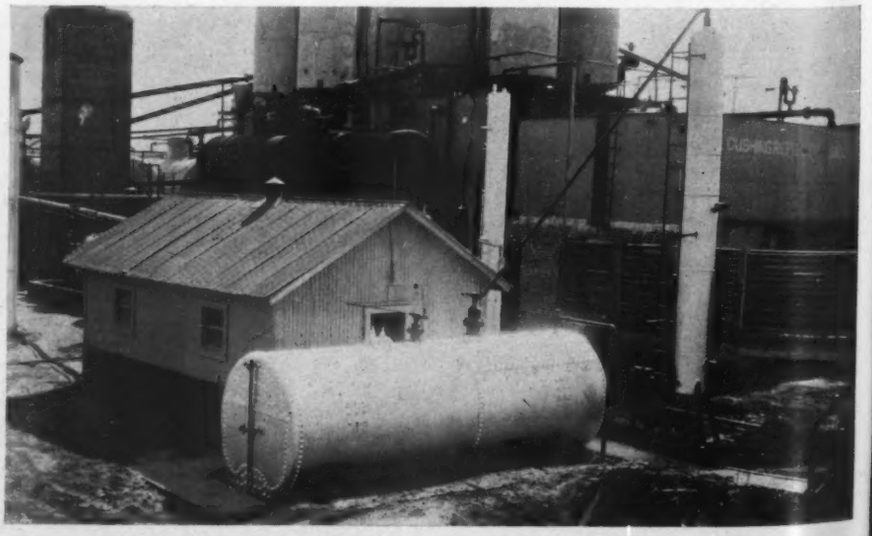
After this washing the gases are taken to the stills and consumed as fuel. It is said that the volume of gases thus recovered and burned is more than sufficient to offset the cost of steam necessary to operate the compressor and pump at the recovery plant. This is another item of economy in connection with the installation. Through the consumption of the stripped gases the recovery plant is made to "pay its own way."

Since the storage tank is held under plant operating pressure, it is necessary that the volume of gasoline be measured from the outside by means of gauge glasses. In this case the gauge is permanently attached to the tank with the scale in feet and inches painted on wood, and fastened securely behind the gauge glasses.

When the naphtha in the system reaches the required gravity of 58 to 59 it is blown out of the system under its own pressure to gasoline storage. The system is then recharged with fresh naphtha coming from the refinery tanks and transferred there by the gasoline pump in the main pump house. When the volume of "blend" in the storage tank reaches a predetermined measure as indicated by the level of gasoline in the gauge glasses, a sample is drawn and the gravity checked.

The Cushing Refining and Gasoline Company refinery at Cushing is rated at 2500 barrels capacity. Its gasoline recovery plant, brightly painted with a coating of aluminum, is evidence of a desire for efficient operation and good economy. The fact that this recovery plant was very cheaply installed, is virtually home-made, or at least constructed of materials on hand at the plant, and that it is made "self supporting" through the use of the stripped gases under the stills, sets it apart from the usual installation of this type.

Maintenance Engineering Corporation, Houston, announces a connection with Neilan, Schumacher & Company, Los Angeles, manufacturers of a line of regulating devices, ball bearing construction. Maintenance Engineering Corporation will maintain a large stock of Neilan regulating equipment in its Houston warehouse to meet any urgent requirements. This stock at present will consist of reducing, back pressure and vacuum regulators, flow and liquid level controllers, casing head regulators, flow and liquid level controllers, casing head regulators, pump governors, steam reducing valves, balanced lever valves, and gas fuel boiler governors.



Vapor gasoline recovery plant at refinery of Cushing Refining & Gasoline Company, Cushing, Oklahoma. Stripped gases from this plant are burned under the stills.

Announcement

After exhaustive tests in leading oil refineries the Campbell Engineering Co. now offers the

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Overall economies have been demonstrated.

It has proven its value and efficiency—for burning Water Gas Tar; for burning Fuel Oils; for burning Acid Sludge; and heavy Residue Fuels.

It assures Rapid Ignition; Complete Combustion; Reduced Flue Gas Temperature; Reduced Upkeep Cost; and Increased Plant Capacity.

The flame is of low temperature throughout, is of even quality, and spreads out like a broom.

Bottom View, showing fuel port

It is a slow-moving, floating flame, rather than one of high velocity. There are no high temperature spots to affect exposed heating surfaces or the setting by direct or radiant action.

Very little steam is required to atomize the fuel. It can be adjusted for a wide range of capacity with nearly equal economy at all ratings. Simple in construction. Easily installed.

Correct Position, fuel port at top

Let us send you one on trial.
Write for prices and discounts.

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The Campbell Engineering Co., Short Hills, N. J.

Manufacturers of the Campbell Steam Flow Controller for Oil Stills, and Process Systems

Without obligating us in any way, please send information on ( ) the Tar Baby Oil Burner ( ) the Campbell Steam Flow Controller. (See February issue of this publication.) Our problems are approximately as written below.

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Write us if you need this.
SEALED TANK GUAGE—ACCURATE TO 1/16 INCH EACH FOOT—ANY SIZED TANK.

Technological Control of Refinery Process

(*Continued from page 80*)

sults in this field come from the conception of entirely new ideas for processes or products. These usually originate in efforts to solve some troublesome current problem. All such matters serve as the basis for patent applications and, in this way, the company is able to build up a reserve of useful practices of potential value, some of which might acquire great worth. This is particularly true at this time, when the industry is faced with great quantities of very refractory crude oils. The vigorous following of all suggestions in this field, keeps the staff engaged with problems months or even years ahead of current operating requirements and provides experimental data upon which commercial plants can be constructed. The cost for this service is only a small fraction of the real value possible in the ultimate results.

One hardly needs to point out the importance of having first hand information on all new processes, apparatus and products offered to the company. The purpose for which an inventor designed a process may not be of immediate interest to the company, but no one can predict when changing conditions might create a demand for it. Unless are promising ideas are followed up systematically and their relations to current or anticipated problems fully known, the company will not be in a position to estimate their possible values, and, therefore, will be handicapped in negotiating for the purchase or use of those considered important. Not to be overlooked in this field are the personal contacts company representatives are able to maintain with leaders in kindred lines of business. These contacts throw into relief the prevailing trends in the industry and focus the attention on probable future changes in practice or products. Money spent for this class of work usually does not pay a direct return, but its indirect value is very high.

The patent search division of the activities of a technical staff is virtually a new development and few organizations have pushed this angle of the question to the limit of its possibilities. The potential value of this class of work has been set forth in that section of the paper devoted to this subject. Its primary value, of course, lies in the protection afforded the company against unwarranted infringement suits. Notices of infringement will be voluntarily withdrawn in many instances when opposing patent attorneys can be shown the prior art applicable to the particular case at issue. An organization having such information in shape for immediate use has an insurance policy of value all out of proportion to its low cost. Prior art searches also furnish the company with substantial backing in all patent matters it may wish to press on its own account. With such a fund of information to draw upon, patent attorneys can inform themselves on the vital points in any proceeding and advise when patent protection is worth obtaining.

At our present, highly developed stage of refinery practice, it is only natural that many companies should have overlapping patent protection in certain fields and it is of first importance that each should know exactly where it stands in relation to all the others. Attempts to negotiate agreements for the exchange of rights in such a case cannot be carried out with complete success from the view point of any single company unless that company knows the prior art and has the patent history of all matters involved. When settlements for patent infringements such as are frequnetly awarded by courts are set up against the total cost to a company of its patent search work, it will be seen that no investment of company funds can pay greater real dividends.

The proper management of the huge resources entrusted to executives in the oil industry today calls for the exercise of sound judgment on many diversified activities. The successful administration of such a responsible position rests principally upon the possession of accurate information along the three following lines, knowing (1) as far in advance as is humanly possible what the market will be demanding in quality and quantity of petroleum products, (2) what kinds of crude oils are and will be available, (3) what kind of processes will be needed to produce them at a profit. The organizations that maintain full technical staffs for control of all refinery operations will have the information they need and will be able to hold their places in the front line of the industry. Those that do not, however, will not remain long in the running. The activities of a complete technical staff touch every vital interest of the company and furnish the standards against which the efficiency of all operations are measured. The cost of the service rendered by such a staff is returned over and over again in lower production costs and higher quality of commercial products. To refinery people who have not given serious thought to technical control of refinery operations, our parting word is to go home and at once apply as much as your resources will permit and set aside for expansion a reasonable portion of the gains its practice brings to you.

Problems of Wet Gas Measurement and Measurement Below Atmospheric Pressure

(*Continued from page 67*)

which vary through a much wider range than those of dry gas, and where errors in gas volumes may be of considerable magnitude if densities are not properly determined. Casinghead gas will range in density from .60 to more than 2.0, as compared with air, and the determination of the specific gravity of such heavy gases is attendant with so many variables, because of condensable constituents, that unless great care and proper equipment are used, erroneous results may be obtained. (The gas testing committee of the National Gasoline Association of America has done considerable work along this line during the past year and a half and it is possible that some of the members of that committee who may be present may be able to give us some interesting information regarding these tests.)

A very perplexing problem of wet gas measurement is pulsation. The principal causes of pulsation are pressure variation from the compressors or vacuum pumps, and condensation in the lines. The latter cause can usually be remedied by placing drips in the low places along the gas line. In the measurement of wet gas it is necessary to blow the drips at least once a day, and during the winter months, especially at plants handling very rich gas, it is necessary to blow them three or four times a day. There are some plants that receive a good portion of their production from the drips. It is obvious that if this condensation were left in the lines, accurate gas measurement would be impossible. We have found the orifice meter to be more satisfactory than the positive meter in the measurement of extremely rich gas. If the vacuum lines are kept free of condensation, an accurate measurement may be obtained, while with the positive meter, it is practically impossible to keep the diaphragms an dother working parts free of condensation. Pulsation caused by compressors or vacuum pumps is the most difficult to overcome. It is like trying to weigh a person who is jumping up and down on the scales. Pulsation can be eliminated in order to make a smooth chart by placing "deadeners" in the meter, but as previously mentioned, this practice is usually followed at the expense of accuracy. It has been found to be very helpful in trying to eliminate pulsation, to use a larger pipe for the meter setting than the line. For example, on a six-inch line, to use an eight-inch setting, and on

Billions *of* Bubbles

You can't consistently expect dividends from obsolete absorption plants

Campbell Engineers have reconstructed natural gasoline absorption plants, installing the latest and most efficient equipment—with the result that losses have been replaced by profit. In no instance has Campbell equipment failed to increase gasoline production, even with the same amount of gas.

Actual records prove our case.

CAMEL-DRY GAS

J. A. Campbell

Natural Gasoline Engineer

Consulting — Designing — Constructing

P. O. Box 669 LONG BEACH, CALIF.

Campbell Oil-Froth Absorbers

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an eight-inch line, to use a 10-inch setting, etc.

Gas Lift Problem

In recent developments of the technology of the petroleum industry, it has been shown that gas lift and repressuring have become important factors in the production of oil, which fact presents many problems to the gas measurement division in controlling the volume and pressure of the gas being injected and its subsequent return to the gasoline plant or compressor station. Steady volume and uniform pressure are essential to the successful application of the gas lift.

The type of meters most generally used in wet gas measurement at the present time are the 20-inch and 50-inch differential range orifice meters. However, where exceptionally large volumes are being handled, meters with 100-inch differential range are often used, while in case of small volumes under vacuum, the 10-inch differential range meter is often used. The 10-inch range meter is particularly adaptable at plants where extremely high vacuum is being maintained, such as at Burkburnett and the Glenn pool. When very high vacuum is required, it is necessary, in order to reduce the friction loss to a minimum, to have as large an orifice opening in the line as possible within the limits of orifice measurement, while at the same time maintaining a differential pressure high enough to insure accuracy. Two or three inches of water differential, therefore, on a 10-inch meter would be satisfactory.

Many other problems might be mentioned if time were permissible, but in conclusion, I wish to say in summary that in the measurement of wet gas, the three factors contributing most to our difficulties, in the order of their importance, are as follows: irregularity of flow, variation in the density of the gas, and measurement at extremely low pressures. Considerable progress in the measurement of wet gas has been made in the past few years, and I believe that with concerted effort on the part of gas men and meter companies, many of our present difficulties will be overcome in the future.

NEW CARBON BLACK PLANT

Amarillo, Texas.—The Dixon Creek Oil Company has closed a contract to supply 15 to 20 million feet of residue gas daily from its gasoline plant for a new carbon black plant, which will be the fourth in the Amarillo district. It will cost approximately $375,000 and will be about three miles from Borger; it is expected to be in operation within two months.

NEW REFINERY AT BILLINGS

The S. C. Fertig interests have been grouped under the name of the Yellowstone Petroleum Company, for the purpose of erecting and operating a complete refinery at Billings, Montana. The new plant will operate on the crude production of the Fertig interests in the Sunburst, Montana, and Wyoming fields.

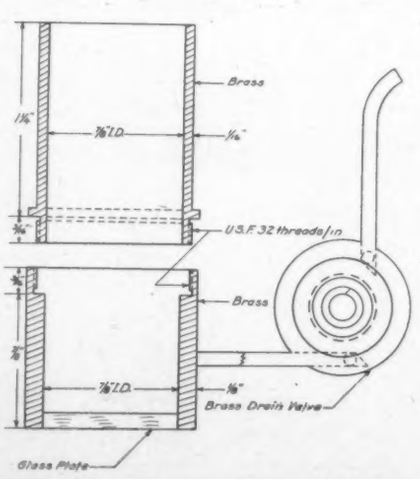
Suggested Improvement for Oil Tube of Saybolt Chromometer

REFINERY laboratory workers have always found difficulty in the cleaning of the glass oil tube of the Saybolt Chromometer which has for years been the most popular instrument for determining color standards of gasoline and other water white oils.

The oil tube, which is 20 inches in length, is permanently closed at one end with a colorless, plano glass disk, and mounted in a suitable metal collar, provided with a small pet-cock for the purpose of draining the oil from the tube (*Tentative Method Test for Color of Refined Petroleum Oil by Means of the Saybolt Chromometer, Serial Designation: D 156—23 T. A.S.T.M. Report of Committee D-2*, 1927).

The difficulty has not been one of wiping out the straight glass tube, but is, rather, a problem of keeping the inside surface of the plano glass disk at the bottom end as clean and bright as is essential to accuracy. Chemists are very familiar with the problem of wiping this small and important surface clean by means of a long rod and cotton or soft cloth, which is inserted into the tube from the open end. Many gasolines and kerosenes, even though filtered painstakingly before the color test is run, will after repeated and numerous tests, leave a deposit of foreign matter on the inside surface of the plano glass disc, which must be removed, and sometimes very often, to insure accuracy of the test.

Chief Chemist, Fred J. Mechlin, Louisiana Oil Refining Corporation, and his staff of assistants at that company's Bossier City Refinery, have devised and perfected a new type of collar to be used in connection with the oil tube of the popular instrument, which they have offered as a suggestion for improvement in design of the instrument, to the A. S. T. M.



Valve assembly for oil tube of Saybolt Chromometer.

The accompanying drawing illustrates in detail the manner in which the "Loreco" laboratory staff have overcome all of the objectionable features of the former design, and perfected a brass collar of standard specifications which makes possible great ease of cleaning both the oil tube and the plano glass disk.

In this new and suggested improvement the brass collar incasing the lower end of the oil tube and the glass disc at the bottom of the tube, is divided into parts. The lower part of the brass collar is the holder for the plano glass disk, and is also provided with the brass outlet line leading to the drain valve used to drain liquid from the tube.

The lower section of the brass collar is provided with fine threads inside, while the upper portion of the collars, which encloses the end of the glass oil tube is provided with threads on the outside. This work was done and the brass collars made according to A. S. T. M. specifications by the company's master mechanic working in collaboration with the laboratory staff.

"The advantage," says Mr. Mechlin, in a letter to the writer, "of being able to clean the glass disc in this apparatus by merely unscrewing the lower part of the brass collar, rather than attempting to clean it by using a swab at the end of a long rod is obvious." Certainly the innovation in design of the Chromometer should be of interest to all refinery and natural gasoline plant chemists, since it not only effects a great saving of time and trouble, but makes real precision and accuracy possible in color readings.

Another suggestion regarding the "color machine" as it is affectionately termed by the trade, consists of having the instrument maker scale the metal face of the tube support, so as to correspond in heighth to the graduations on the standard tube. By scaling the "back" or support in this manner, the laboratory can go ahead with fair accuracy in the event of breakage of the scaled or graduated glass oil tube. In fact there is possibility of using plain glass oil tubes exclusively as against the higher priced graduated or scaled oil tubes.

FLUID-FUSION

WELDED CRACKING STILLS

TECHNOLOGY OF FLUID-FUSION WELDED STILLS

P. I. W. Fluid-Fusion welded stills should not be confused in any way with ordinary welded products because Fluid-Fusion welding differs from ordinary welding in the following ways:

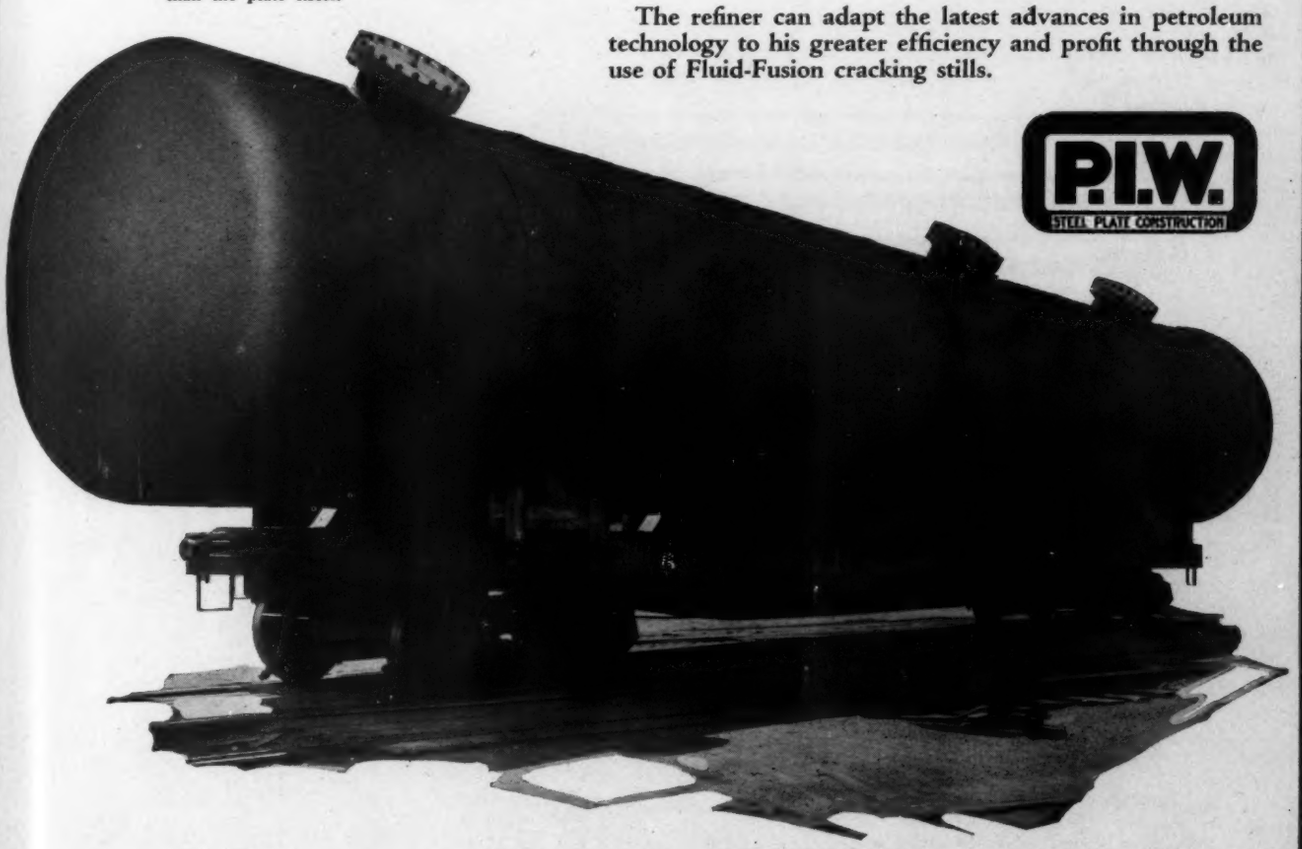
- **It is automatic and eliminates the variable human element.**
- **It is a combination of chemical, mechanical, and electrical action.**
- **It excludes such impurities as oxides and nitrides and bonds the parts together so perfectly and intimately that a joint can hardly be said to exist.**
- **It eliminates the so-called "zone of weakness."**
- **It always withstands far greater tension and torsion stress throughout the weld area than the plate itself.**

AN OPEN MIND

The progressive refiner in search of better equipment will not allow traditional distrust or preconceived notions to keep him from giving to Fluid-Fusion welded stills the open minded consideration these unusual features merit:

Wall thickness exceeding rolling mill limits. Dimensions which tax transportation limits. Bottle tightness under tremendous pressures and temperatures without extensive shutdowns.

The refiner can adapt the latest advances in petroleum technology to his greater efficiency and profit through the use of Fluid-Fusion cracking stills.



The Petroleum Iron Works Company

SHARON, PA.

Branch Plant: Beaumont, Texas

NEW YORK CHICAGO HOUSTON TULSA

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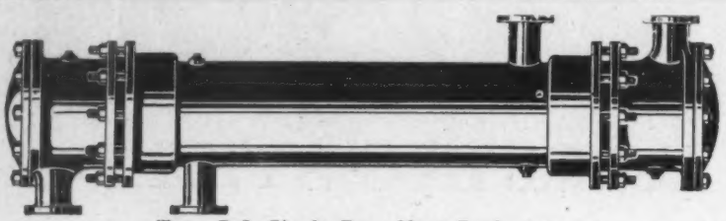
NEW EQUIPMENT, CATALOGS, BULLETINS, BOOKS



Type S L Single Pass Heat Exchanger

All the tube holes are finished to exact sizes and the edges of the holes are slightly rounded.

Tubes can be supplied in brass, admiralty metal, copper, steel or alloy.

The full floating head construction permits the tubes and one plate to move freely in a longitudinal direction.

All tubes over six feet long have tube supports to prevent sagging.

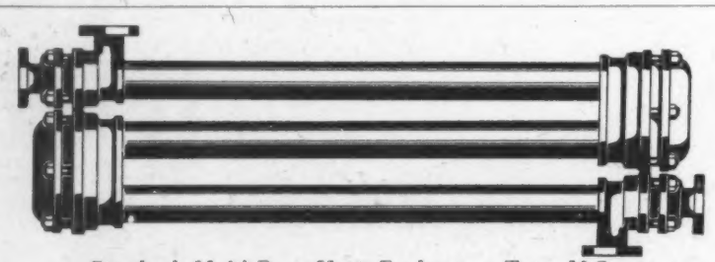
New Heat Exchanger
STRUTHERS-WELLS COMPANY

Struthers-Wells Company, Warren, Pennsylvania, announce a new heat exchanger to the refining industry.

Provision is made for full freedom of expansion and contraction of tubes. Also unusual care has been taken to produce a heat exchanger that will not leak through the gasket surfaces.

The tube bundle is removable, making it possible to replace the shell should this become necessary.

Standard Two-Pass Heat Exchanger, Type T



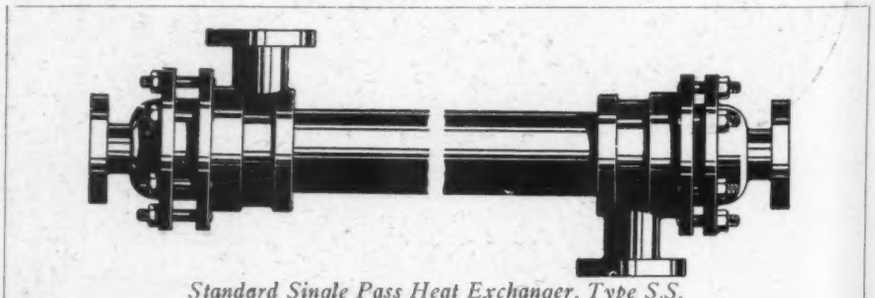
Standard Multi-Pass Heat Exchanger, Type M.S.

Five standard types are made.

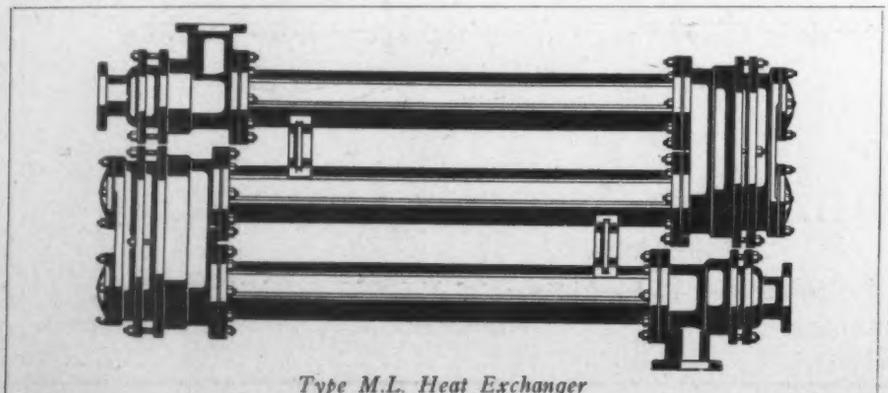
The shells are made of steel or cast iron as required. On the steel shells the end flanges are of pressed steel and are welded to the shell end. Cast iron shells have the flanges cast integral. The recess for the tube plates are machined after the flanges are secured to the shell.

Heads are constructed of cast iron, semi-steel or cast steel as necessary.

Tube plates are furnished in rolled steel, brass, copper or alloy as desired.



Standard Single Pass Heat Exchanger, Type S.S.



Type M.L. Heat Exchanger

Type SL Single Pass

Type S L is made in standard diameters from 12 to 30 inches and in tube lengths from six to 20 feet. This Type can be supplied with either steel plate, alloy or cast iron shells or with steel composition or alloy tubes.

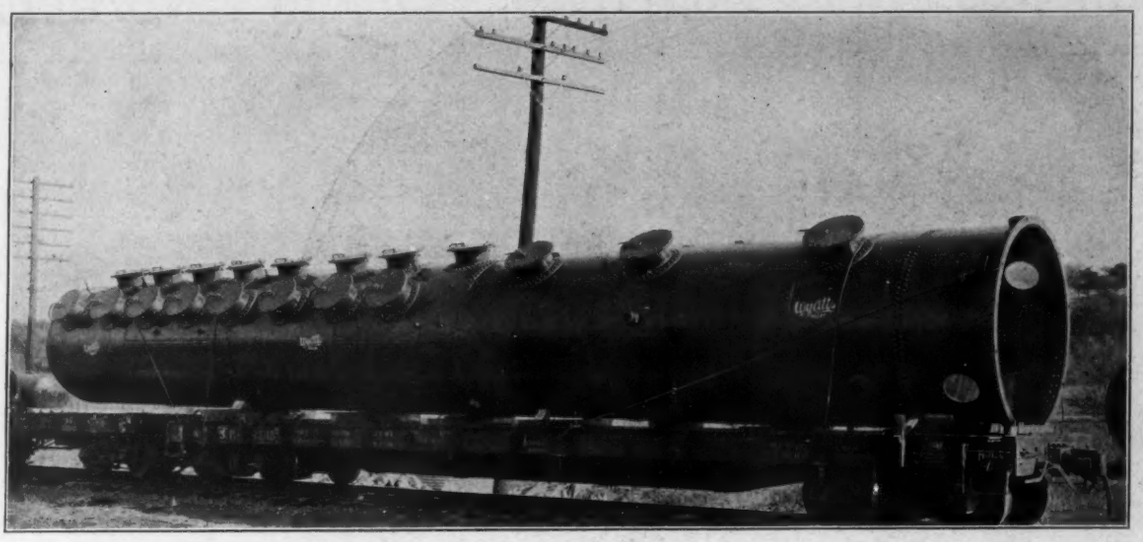
Standard tubes are three-fourths inches outside diameter but other sizes are furnished to meet special requirements. This type is built standard for 125 pounds working pressure on both shell and heads. Special exchangers can be supplied for pressures up to 1000 pounds.

Type T Two Pass

The two pass type is designed for conditions where the temperature differences in the fluid path are not excessive. These units can be connected in series to provide longer vapor or fluid travel.

Type S S Single Pass

This type is suitable either for a single pass unit or as a multiple pass heat exchanger in as many units as desired. When it is of advantage to cut



A Product of the Wyatt Shops—Bubble and Vaporizer Tower 63′ in length—8′ in diameter

Bubble Towers, Vaporizers and Absorbers are turned out in the Wyatt Shops regularly and satisfactorily for an increasingly large number of Oil Companies and Refineries in the Southwest.

WYATT METAL & BOILER WORKS
DALLAS, TEXAS

Wyatt's **WYATT METAL & BOILER WORKS**

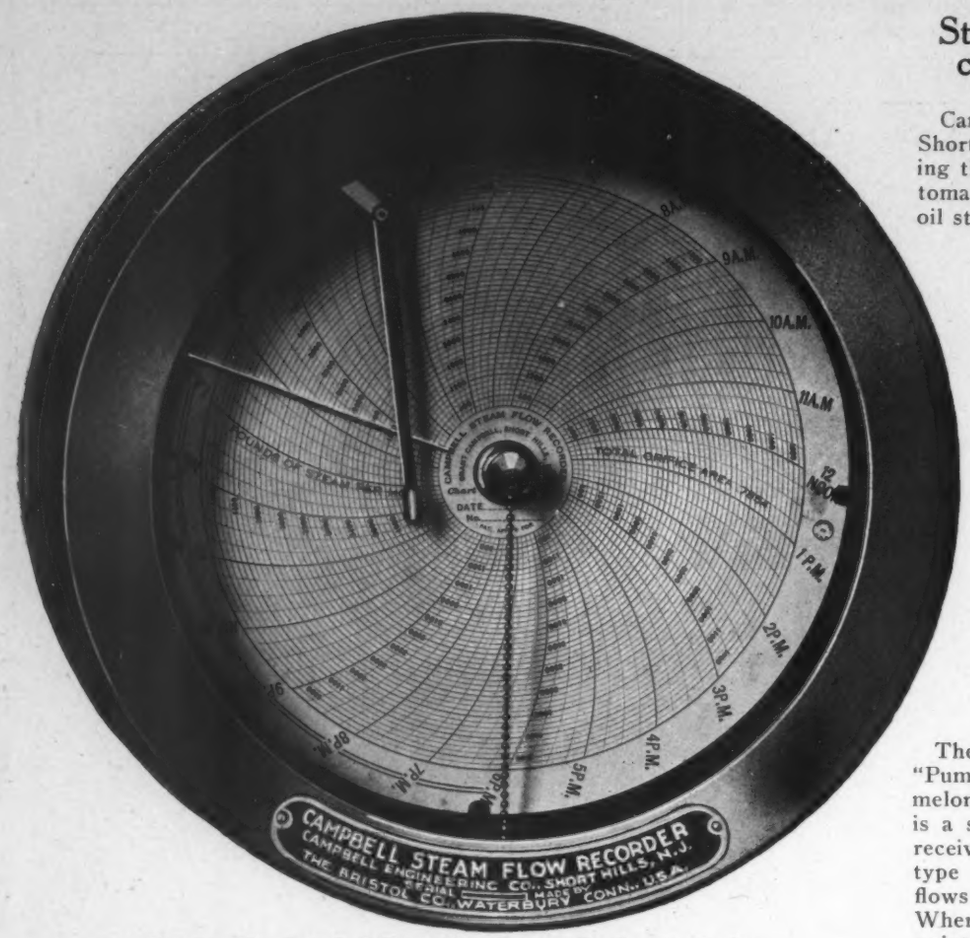


Fig. 3.—The Campbell Recording Gauge. Reads directly in pounds of steam per hour.

out a section for cleaning or inspection, the units are connected up with valves and by-passes so that any unit can be cut off from the system without interfering with the general operation.

Type M S Multi-pass

The multi-pass type is for use where a very long fluid or vapor travel is required. It can be furnished in from two to any number of sections or passes required.

Type M L

The type M L is of the same general principle as the type M S. The shells, however, are provided with welded steel flanges which bolt to the return ends of headers. The ends opposite the tube plates are furnished with removable covers to provide convenient access to the tube ends. The field of application is almost identical with that of the type M S.

Book Notice

The American Asphalt Paint Company, 844 Rush Street, Chicago, has prepared an interesting booklet "In the Long Ago," which deals with the discovery and development of the now famous deposit of Gilsonite, discovered by Sam Gilson in the days when Utah was still a territory. The large asphalt deposit lies in northeastern Utah near the town of Vernal. The cover and inside art work for the booklet was done by Lone Wolf, famous Blackfoot Indian artist. Copies of the book will be sent free to any one requesting it.

Bulletin Notice

The Superheater Company, 17 East 42nd Street, New York, announces publication of a bulletin on superheaters. "Elescooperation" is the title of the publication. Its contents are devoted exclusively to superheaters and their application to industry. Copies of the bulletin may be secured by request to the company.

Robinson Orifice Fittings are described in a catalog being distributed by the B. & A. Specialty Company, 220 East Brady Street, Tulsa. These fittings are recommended for any orifice installation measuring air, gas, water or oil. Copies of the bulletin may be obtained on request to B. & A. Specialty Company.

C. H. Wheeler Manufacturing Company, manufacturers of condensers, pumps and cooling towers, announce that the Fulton Engineering Company, 620 American Bank Building, Los Angeles, has been appointed its agent for Southern California.

Steam Flow Controller

CAMPBELL ENGINEERING COMPANY

Campbell Engineering Company, Short Hills, New Jersey, is announcing the Steam Flow Controller for automatically regulating steam flow to oil stills.

The device controls the rate of flow of steam in process work, as for example to oil stills, where it is necessary to deliver steam to low pressure vessels at constant flow rates, recording and indicating such flow simultaneously. The recorder and indicator both give the flow rate directly in pounds of steam per hour, which may be varied as the operator desires. It differs from a meter in that it controls and records steam flow at the desired rate.

Essentially the controller consists of a flexible combination of receiver, calibrated nozzles and recording or indicating instruments.

There are two types, the so-called "Pumpkinseed" type and the "Watermelon" type. The "Pumpkinseed" type is a single controller having only one receiver and one orifice nozzle. This type is used where relatively small flows are desired, as on steam lifts. When proportionate flows to two points is desired, two receivers, two orifice nozzles, and one recorder may be combined by connection with a common pipe into a double controller.

When larger quantities are to be used, the "Watermelon" seed type serves and when fitted with two cali-

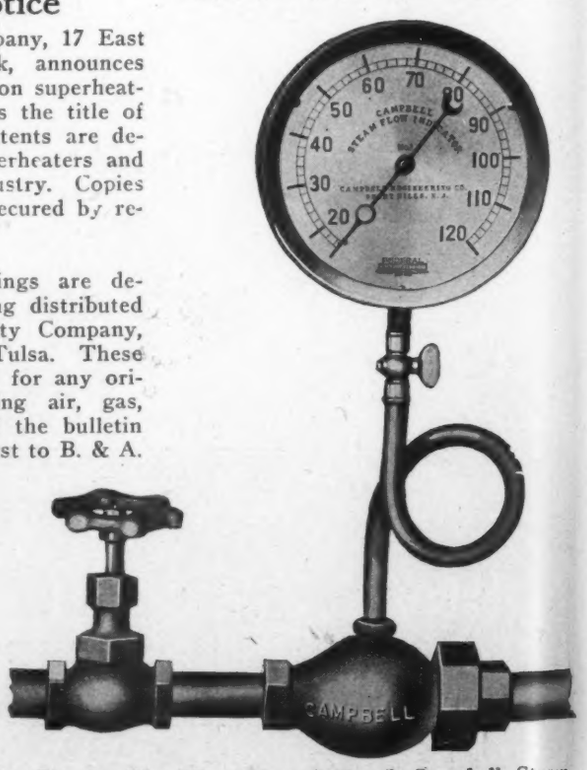
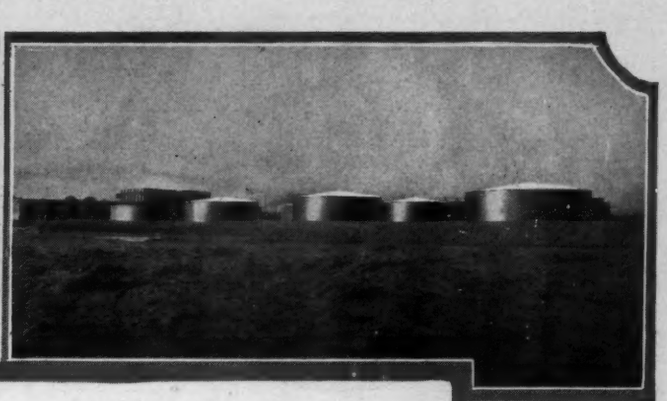


Fig. 1.—The "Pumpkinseed Type" Campbell Steam Flow Controller with Indicating Gauge.



"The Sun Never Sets on Hamondtanks"

The "Copyrighted Slogan" tells the story.

In every country where Petroleum Products are stored in steel tanks Hammond Tanks are used.

Steel tanks in capacities up to 100,000 barrels; knocked down or erected.

Oil Refinery Equipment, Stills, Towers, Agitators, etc.

Send for—

Our Bulletin No. 300—Hammond Filters.
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HAMMOND IRON WORKS

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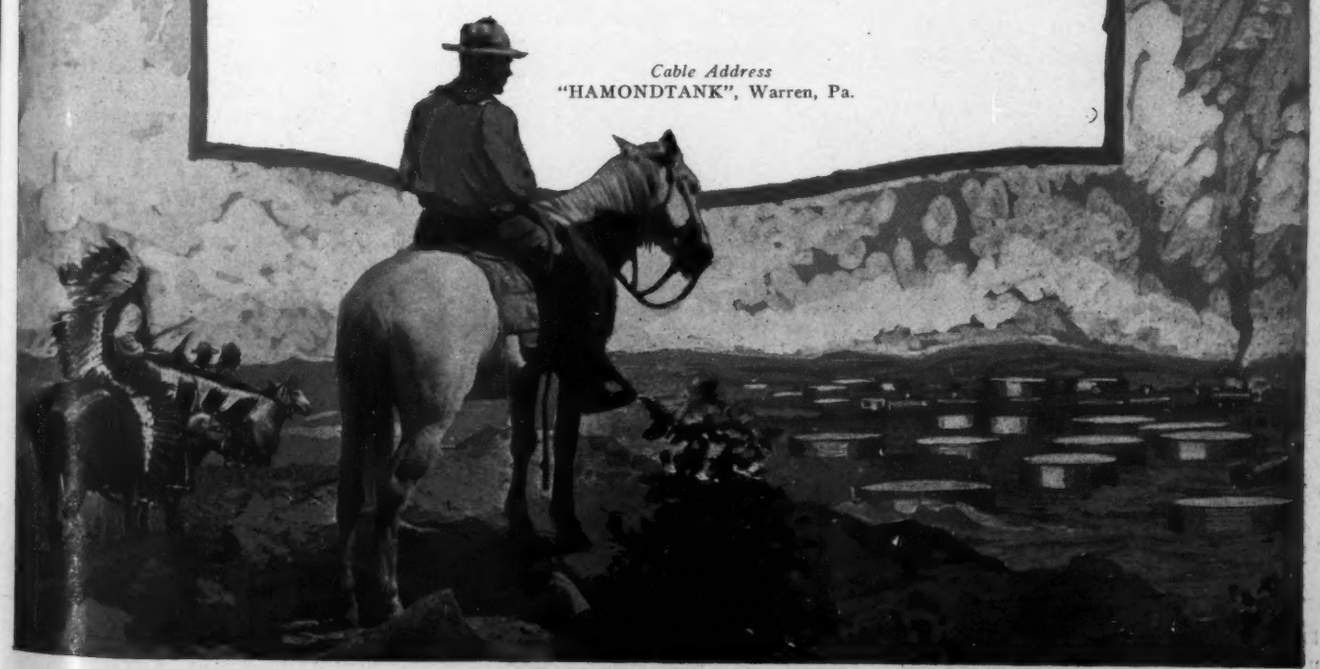


Fig. 2—The "Watermelon Type" Campbell Steam Flow Controller with Recording Gauge.

brated orifices will proportion the flow to two points in the ratio of the orifice areas.

The recorder is uniform and interchangeable for all service conditions. It indicates and records the flow in pounds of steam per hour. Where a permanent record of flow of steam is not essential, indicators are furnished and are designed to match the orifice used. They too, read flow directly in pounds per hour.

For example, if 165 pounds per hour is desired, use a No. 3 calibrated orifice nozzle and adjust control valve until the recorder shows 165. At this reading the receiver pressure will be about 40 pounds.

Further details will be supplied by the company on request.

Natural Gas Equipment Company, Los Angeles, recently established permanent Mid-Continent branch offices at 224 Atco building, Tulsa. William Chase is in charge of the new branch. Natural Gas Equipment Company is national sales representative for the manufacturers of Wilgus equipment for use in refineries and natural gasoline plants and the producing branch of the industry. The Wilgus back pressure regulator, differential regulator, vacuum regulator and gas burner regulator all are well known on the Pacific Coast. Other devices of the same company have also been marketed in the West for several years, and the opening of the Tulsa branch office marks the entry of this company into the Mid-Continent territory. Natural Gas Equipment Company is the manufacturer and marketer of the National Liquid Level Controller and National Low Pressure Gas Burners.

Improved Plug Valves

BARCO MANUFACTURING COMPANY

Barco Manufacturing Company, 1801 to 1815 Winnemac Avenue, Chicago, has published a new bulletin on Barco Lubricated Plug Valves.

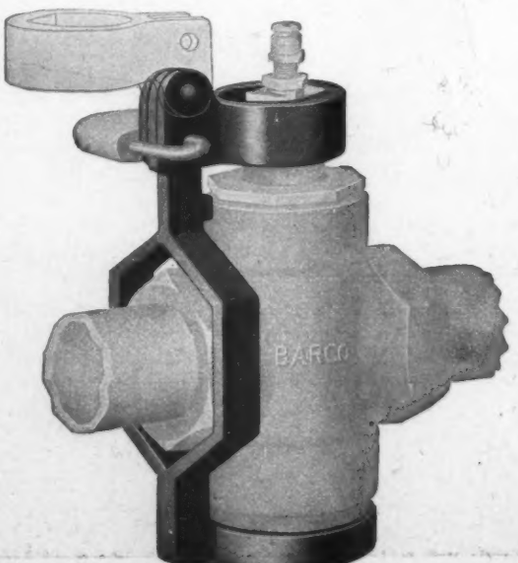
Three new developments are mentioned in the bulletin:

Barco Steam Jacketed Valves For Hot Asphalt Tar, Etc.

The steam jacketed valve is kept at the correct temperature by means of a steam jacket at the large end of the plug, providing for constant passage of live steam.

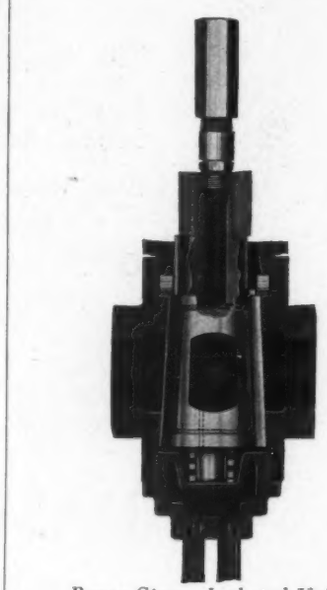
Locking Attachment

A locking attachment for plug valves provides a device which cannot be removed without removing the valve from the pipe. It locks both ends of the valve as well as the operating stem. The device is easily thrown back out of the way when not required.



Valve Locking Device

Air Hoist Valve



Barco Steam Jacketed Valve

Special Air Hoist Valve

A special air hoist valve designed for operating shop air hoists is announced. It is operated with a cross handle to which an operating chain is attached. This valve is provided with a special triangular port through the plug for smooth operation of the air-hoist.

Further details will be provided by the company, on request.

DOUBLE CAPACITY

Los Angeles.—The daily capacity of the natural gasoline plant of the Gilmore Oil Company at Long Beach is being increased from 15,000 to 30,000 gallons.

EQUIPMENT will be found to *predominate* in all Mid-Continent Fields. In use by Manufacturers of Natural Gasoline from the *smallest* to the *largest.*

TULSA
Boiler & Machinery Co.
TULSA OKLAHOMA

REFINERY AND GASOLINE PLANT ACTIVITIES

New Plants – Construction Notes – Personel Changes

Dubbs Battery Connected By Safety Walkways

AS a measure of both safety and convenience the Shaffer Oil & Refining Company, at its Cushing, Oklahoma refinery, has installed steel stairways leading to the working platforms at the base of the dephlegmators on the Dubbs cracking units. In addition the five units are connected by steel platform runways suspended high above ground which tie the units together and provide means of walking from one unit to another without descending to the ground.

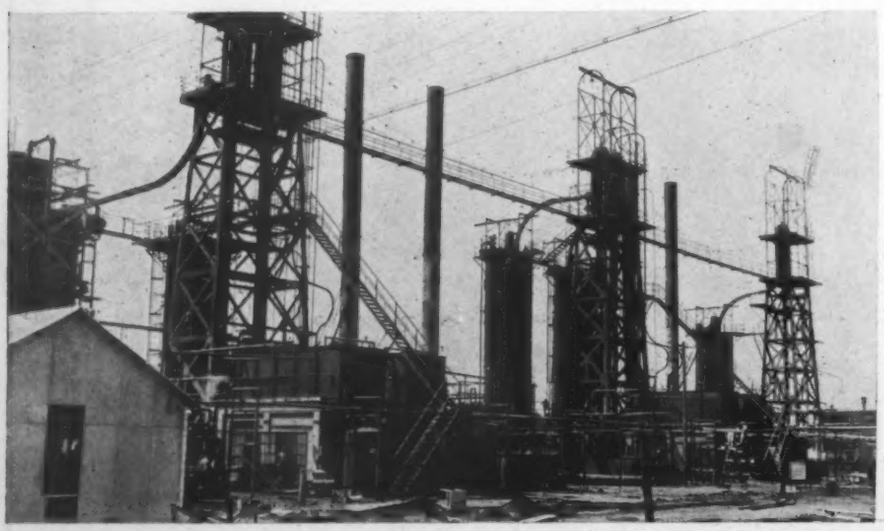
These walkways are suspended on steel cables much after the same manner that the common type of suspension bridge is installed. The ends of the platforms are permanently and securely attached to the fromework supporting the tower equipment of the cracking units. The construction is all steel and heavy cables, with sturdy hand rails of pipe work about four feet above the steel platform acting as guards and lending to the safety feature of the walkways.

Too often cracking plant fires have occurred with workmen busy on the unit or on adjacent units and in such a manner that workmen have been trapped while performing their duties at the top of the dephlegmators or towers, with the result that serious burns were suffered, or death. Jumping usually results in broken limbs.

Many operators of cracking units have provided guy-wire aerial tramways extending from the tops of the dephlegmators to earth as a safety measure. These devices have much to commend them and experience has shown that three men trapped at the top of the towers by flames breaking out in the lower section of the tower or unit, have been able to ride to safety about 100 feet away from the unit in three minutes. Other companies, and among them the Shaffer organization, favor the installation of stairs and steel run ways, since it is claimed that workmen trapped on any one unit, in the event of fire, can leave the danger zone more quickly by running over the suspended runways to any of the other units and descend to the ground by means of the steel stairs. Certainly the platforming offers opportunity for more men to leave the dangerous area at once.

In addition to the safety factor there is that of convenience. With approaching stairways provided and interconnecting walkways between each of the units, workmen can reach the job with greater ease than climbing vertical steel ladders. With the suspended platforms installed the crew can be moved from one unit to another without climbing down from the first units, and up to the second. Through this arrangement it is but a matter of a few seconds for a workman to go from unit No. 1 to unit No. 5 and return on any errand.

As a means of speeding up inspection of the entire unit the installation of walkways is important. Not only does it make the work of going over the entire battery much easier but because of that same factor it makes for greater willingness on the part of operators to inspect both more thoroughly and perhaps more often.



Safety stairways and steel platform walkways connecting battery of five Dubbs units at Shaffer Oil & Refining Company's Cushing, Oklahoma, refinery

INCREASE CAPACITY

Houston.—The capacity of Humble Oil & Refining Company's refinery at McCamey, Texas, will be increased to around 20,000 barrels through the installation of three return-tube shell stills.

SAFETY SCHOOL IN EAST

Cleveland.—The Fire and Safety Marshals of the National Petroleum Association have taken advantage of the offer which they were made by representatives of the Bureau of Mines at their January meeting to teach the refinary workers first aid methods; and such instruction is now being carried on in Warren, Pennsylvania, the first center to receive the training, by H. R. Burdelsky and Joseph S. Ferraro, field representatives of the Bureau. The first aid classes in Warren are held afternoon and evening in the Y. M. C. A.

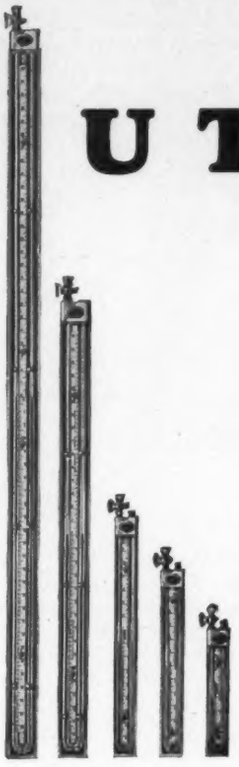
The Fire and Safety Marshals were formerly organized under the name of the Fire Marshals of the National Petroleum Association, but the name was changed so as to take in new activity, the prevention of accidents, that the association assumed at its annual meeting in Pittsburgh on January 12.

START CONSTRUCTION

Breckenridge, Texas. — The Ward Gasoline Company has started construction work on a high pressure absorption gasoline plant on the J. T. Ball lease in the southeast part of section 1230, T. E. & L. Survey, Stephens County. This plant is to be equipped to handle about 6,000,000 cubic feet of gas daily, and the estimated daily recovery of natural gasoline is placed at 5000 gallons. Most of the gas supply will come from the I. A. Sloan and J. T. Ball leases owned by Pace & Ward, who are also the principal owners of the plant. The Ward Gasoline Company maintains headquarters at Breckenridge, and was recently organized by John W. Ward, F. F. Seegar and James E. Allison, with a capital stock of $40,000.

SYNTHETIC GASOLINE IN GERMANY

Chem. & Met., Vol. 35, No. 4, April, carries the following interesting item: —"Last year is interesting with regard to the production and consumption of oil in Germany, as it is the first year in which oil produced from coal has appeared upon the German market in commercial quantities, states Consul Hamilton C. Claiborne. Toward the close of 1927 in I. G. Farbenindustrie A. G. of Frankfort was producing synthetic gasoline at the rate of 1200 tons per month, with a program calling for production during 1928 at a rate of 10,000 tons monthly."



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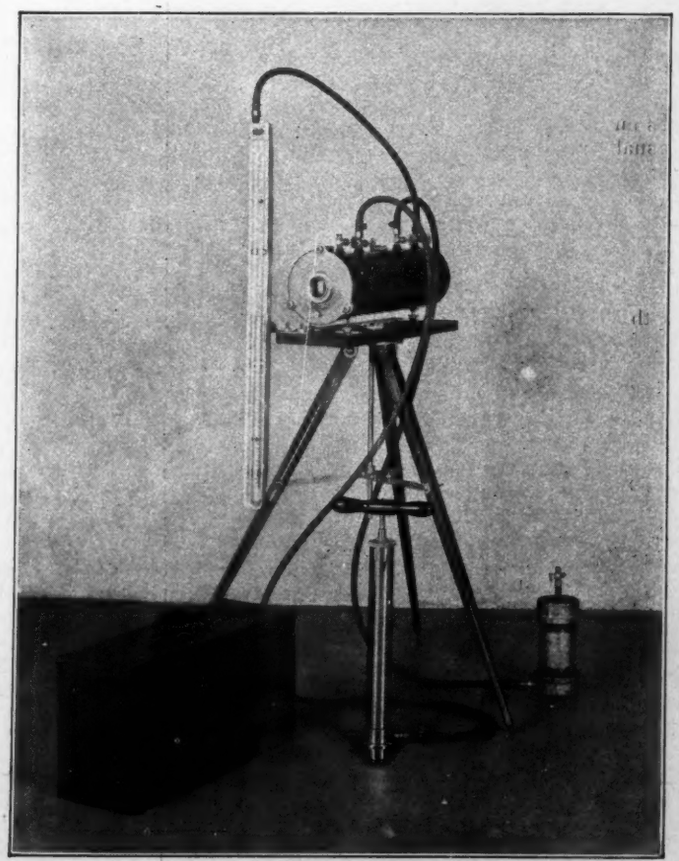

The Refinery Supply Co.

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GRAY COUNTY PLANT

Amarillo, Texas. — The Coltexo Gasoline Corporation is starting construction work on a 20,000,000 cubic foot daily capacity natural gasoline plant in the LeFors pool, located in eastern Gray County. The plant will be located in section 1, A. C. H. & B. survey, block 1, and on the Navillus land. It will be a joint enterprise by the Columbian Gasoline Corporation, Monroe, Louisiana, and The Texas Company, and most of the gas will be furnished by The Texas Company. About 18 miles of three-inch line will be built to load the natural gasoline at the nearest railroad point. A carbon black plant will be erected by the Western Carbon Company to burn the residue gas from this plant.

MAUD PLANT IN OPERATION

Maud, Oklahoma. — Gillespie and Moran, Inc. have completed construction and started operating its absorption natural gasoline plant in the St. Louis Pool. The exchanger, after coolers, preheaters, and other equipment, with exception of the absorbers are Tulso-Type, made by the Tulsa Boiler and Machinery Company. The new installation has a capacity of 20,000,000 cubic feet of gas daily. Its location is in the southwest of the northwest of section 15-7-4.

RUSSEL REFINERY TO OPERATE

Russel, Kansas.—The Russel County Pipe Line Company's refinery which has been inoperative for the past several months, is to be reconditioned and placed in operation in the near future. The plant has a rated capacity of 2500 barrels, and is equipped with late type bubble tower fractionating equipment. The Russel County Pipe Line Company is controlled by the Derby Oil Company.

WILHOIT REFINERY OPERATING

Joplin, Mo.—The Wilhoit Refining Company, after a shut-down of several weeks, has resumed operation of its skimming and cracking plant. C. S. Banks is general manager and has charge of plant operation. The plant has a rated capacity of 1000 barrels and cracking unit capacity of 1000 barrels, Jenkins type.

RESUME OPERATION AT ARDMORE

Ardmore, Oklahoma.—After a shut down period extending over several months, during which time the skimming plant was reconsditioned and repaired, the Pure Oil Company resumed operation of its Ardmore refinery early in April. The plant has a rated capacity of 5000 barrels, with a cracking capacity of 2000 barrels, consisting of four Dubbs Units. John Jeffrey is superintendent.

MEETING DATES CHANGED

Bradford, Pennsylvania.—The Eastern district of the Division of Development of the American Petroleum Institute will meet here on May 18 and 19, instead of on May 1 and 2 as formerly planned. The first day of the session will be devoted to the presentation of papers and discussions on production problems in the Eastern fields, and the next day will be spent in field trips, on which the flooding methods for increasing recovery in the Bradford-Allegany area will be demonstrated.

RELOCATE LUBE PLANT

San Antonio.—The Golden West Oil Company of San Antonio has purchased a refinery at Cisco, shipped it to Hondo, and will erect it in the Ina field of Medina County for running off lubricants only from Ina crude.

Ina crude is heavy, 16 Beaume gravity, with a low cold test; and furnishes about 60 per cent. of low cold test motor oils with proper refining.

The capacity of the Golden West refinery will be about 200 barrels of crude daily. It will be located on the Hondo River, directly in the field, and will use fuel gas from a gas property of the Golden West located about a mile distant. The products will be marketed locally.

The Golden West has about 300 barrels daily production in the Luling field, in addition to about 20 wells in the Ina field. It also has considerable undrilled property in the Ina field and will undoubtedly drill additional wells as neeed.

W. E. Olmstead is head of the Golden West, and a Mr. Rathbone has been employed to run the new refinery.

UTILIZE WASTE GAS

Casper, Wyoming.—Planning to install three motor-driven duplex compressors, capable of handling 5,000,000 feet of gas daily, the Midwest Refining Company is building a gasoline plant in the Salt Creek field to run the waste gases from its producing wells.

Heretofore all of the waste gases have been gathered and burned in a single great torch, but through the erection of the gasoline plant the torch will be eliminated; several thousand gallons of gasoline will be recovered daily, the content of gasoline, however, being relatively low; and the remaining gas will be forced again into the pay sands, repressuring them.

INCREASE CAPACITY

Tulsa.—The Carter Oil Company, through the addition of a booster station to its No. 9 plant in the Burbank field, will increase its gas deliveries about 5,000,000 feet; and the increase in the production of the unit will be about 5000 gallons daily.

COMPRESSED GAS PLANTS

New York.—Linde Air Products Company has awarded general contract for the construction of a compressed gas plant at Harrisburg, Pennsylvania. At Charleston, West Virginia, another plant, 130 by 130 feet, has been contracted for early construction. These plants are part of the general program for production and distribution of household gas fuel in cylinders, as is being nationally advertised at present by the company.

LION OIL BUILDING

El Dorado, Arkansas.—Lion Oil & Refining Company has under construction a new receiving house, of brick and concrete construction, estimated cost, $42,000. This in connection with a new refining process which is to be placed in operation in the near future.

NEW MEXICO PLANT

Denver.—An absorption type natural gasoline plant of 5000 gallons daily capacity will be built by the Angel Peak Oil & Gas Company in the Kutz Canon district of San Juan County, New Mexico.

DIXIE STARTS PLANT

Shreveport, Louisiana. — Dixie Oil Company is now operating the old Paramount Refinery at Superior, five miles north of Oil City, having completed the renovation of it the latter part of April. It is a topping plant of 5000 barrels daily capacity. It is now running only Dixie's own oil from the Pine Island field; but when the company's present stock of approximately 75,000 barrels in storage is exhausted, it will take oil from outside producers at Pine Island.

CANADIAN TARIFF CHANGE

Washington, D. C.—Among the additional tariff changes passed by the Canadian House of Commons, according to reports from the Department of Commerce, the following is of interest to the refining industry. Crude Petroleum not in its natural state, .725 specific gravity or heavier but not heavier than .770 specific gravity at 60 deg. F. temperature, when imported by oil refiners to be refined in their own factories, will be admitted free of duty from all countries, until July 1, 1931.

REFINERY AT LAREDO

Laredo, Texas.—Construction has been started here on the new refinery of the Motor Fuel Products Company, a recently organized company; and is expected to be completed by August 1. It is in the city limits of Laredo, and will operate on Mirando crude. The capacity of the plant will be 2000 barrels a day. S. P. Coblentz is head of the new company.

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The best indication of the economy and business sense of car leasing is the number of large shippers who lease all or part of their special car requirements.

Well able, if they desired, to operate their own fleets, they find it more profitable to stick to specialization—directing their capital and energies to the furtherance of their own business and leaving to the car lessor the outlay of capital, the task of keeping cars modern and well conditioned and the expense of interest, taxes, depreciation and obsolescence.

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Aransas Pass

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Petroleum Exposition to Be Annual Affair

TULSA, OKLA. — Following a decision to make the International Petroleum Exposition and Congress an annual affair, directors of the organization have begun preparations for the 1928 meeting, which will be held in Tulsa, October 20 to 29, inclusive. J. Burr Gibbons, general manager in 1927, has been selected to manage the 1928 exposition and has opened offices in rooms 207 and 208, Drew building.

One of the first moves of officials was a reduction in rates for space. This amounts to 25 per cent. under charges in 1927. Details of the lower prices were given in the following letter to exhibitors of 1927:

"We are happy to announce a further reduction of $50 per booth on all inside space and a proportionate reduction on the outside, open air spaces. This brings the regulation booths down to $150 each, as against $200 in 1927 and $250 in the previous show. Outside space is reduced to 75 cents per square foot, as against $1 in 1927 and $1.25 in 1925. The customary extra charge of $50 will be made for corner booths as in the past."

Exhibitors of 1927 are being given first call on space they used in 1927. Exhibitors have until May 15 to decide on this space. Space reservations are already being received at such a rate as to indicate an exposition of larger proportions than in 1927.

The dates selected for the coming exposition are about one month later in the year than in 1927. This change was made to endeavor to avoid bad weather, which was the only drawback in 1927. Changes in buildings, grading and building concrete walks also will help to counteract any bad weather. Buildings will be equipped with natural gas for heating.

C. D. Wertzberger has been appointed superintendent of buildings and grounds. J. S. Monroe will handle publicity.

The executive committee has been announced. It consists of all officials of the exposition, W. G. Skelley, president; Frank Hinderliter, vice president; Alf G. Heggem, vice president; A. W. Leonard, treasurer; William Holden, secretary, and J. Burr Gibbons, general manager; as well as the following from the board of directors: W. M. Bovaird, Bovaird Supply Company; George A. Dye, Western Supply Company; R. A. Griffith, Sinclair Oil & Gas Company; Ernest Nicklos, The Texas Company; Waite Phillips, Independent Oil & Gas Company; R. C. Sharp, Oklahoma Natural Gas Company; J. S. Sidwell, Prairie Oil & Gas Company; D. D. Wertzberger, Wertzberger Derrick Company, and R. M. Young, the Carter Oil Company.

Other directors of the exposition are Clyde Alexander, Phillips Petroleum Company; A. A. Beard, Tidal Oil Company; A. F. Bourne, Oklahoma Iron Works; J. H. Brooks, Republic Supply Company; S. W. Campbell, Tulsa Storage & Transfer Company; Howard N. Cole, Pure Oil Company; O. T. Dawson, National Supply Company; C. P. Dimit, Gypsy Oil Company; R. L. Dudley, Gulf Publishing Company; Robert W. Egan, Oil & Gas Journal; J. P. Flanagan; H. V. Foster, Indian Territory Illuminating Oil Company; Jacob France, Mid-Continent Petroleum Corporation; Robert F. Garland; Walter Gray, Jarecki Supply Company; Henry Greis, Burge-Greis Oil Company; Brooks Gutelius, Continental Supply Company; P. D. Hayes, Exchange National Bank; J. M. Hayner, Hayner-Reaves & Company; B. E. Horrigan; Fred Insul, Public Service Company of Oklahoma; John M. Lovejoy, Amerada Petroleum Corporation; Joe McGraw, McGraw Oil Company; D. F. McMahon; Walter Miller, Marland Refining Company; Clyde Pape, Selby Oil & Gas Company; J. Edgar Pew, Sun Oil Company; Warren C. Platt, National Petroleum News; J. M. Post, Oil Well Supply Company; Ralph B. Pringle, Independent Oil & Gas Company; Harry H. Rogers, Exchange National Bank; Harry H. Smith, Mid-Continent Oil & Gas Association; Victor H. Smith, North American Car Corporation; O. C. Staples, Frick-Reid Supply Company; W. A. Schleuter, Refinery Supply Company; R. E. Day, Magneto Ignition Corporation.

C. W. STRATFORD

has opened offices at 836 New York Life Building, Kansas City, Missouri, establishing a new petroleum and refinery engineering company headed by himself under the name of Stratford Engineering Company. Mr. Stratford is well known to the refining industry through his engineering work in the modernization of cylindrical stills. He was formerly with the Associated Oil Company.

The skimimng plant of the California Naphtha Products Company, at Signal Hill, Long Beach, California, has been leased by The Davis Oil Company, marketers of refining oils in the southern district of California. The plant has been idle for some months, but is being reconditioned for resumption of operations by the new management in the near future.

RICHFIELD BUYS PLANT

Los Angeles.—The Long Beach topping plant of the Delaney Producing & Refining Company, and the Delaney gathering system have been purchased by the Richfield Oil Company. The Richfield company also recently bought the A. J. Delaney leases at Long Beach, including four producing wells and four drilling tests.

RENOVATE PLANT

Tulsa.—Empire Oil & Refining Company's gasoline plant at Tallant, Oklahoma, has been renovated, and is now practically a new plant. It was built originally in 1916, and the work of putting in new equipment was started about six months ago.

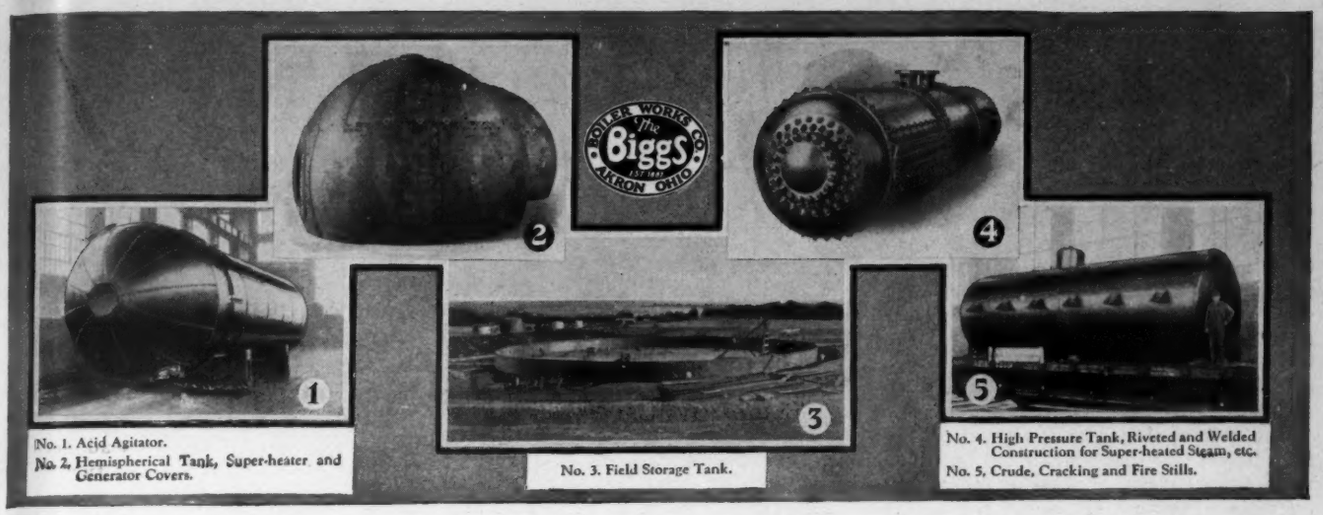
PLANT NEAR COMPLETION

Amerillo, Texas.—Cannon Gasoline Company will place its new absorption gasoline plant in operation sometime during the latter part of May. The plant is of Newton equipment and will operate under high pressure with a daily capacity of 7000 gallons.

KANSAS PLANT RESUMES

Humboldt, Kansas.—The refinery here formerly owned by the Miller Petroleum Company will resume operations soon under the management of the new owners, J. J. and M. Taxman.

K. W. Shimeall, formerly superintendent of the Glen Rock refinery of the Continental Oil Company, is now superintendent of the Sapulpa, Oklahoma, plant, having succeeded M. S. Beringer, who is doing some special engineering work in Roumania. Mr. Shimeall's position at Glen Rock has been filled by A. M. Holvid, formerly assistant superintendent of that plant.



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Natural Gasoline Plants of United States Increase

Latest available figures from the United States Bureau of Mines, Department of Commerce, covering a survey of natural gasoline plants and capacity as of January 1, 1928, indicate both an increase in the number of installations and in over-all capacity of this branch of the petroleum industry.

The survey shows 1555 natural gasoline plants in this country. Of this total .92 per cent., or 1060 plants, were operating January 1. Eight per cent. of the plants, or 95 were shut down. The total capacity for natural gasoline manufacturing is given at 8,048,000 gallons daily. Four per cent., or 294,000 gallons of this total capacity was shut down.

Oklahoma leads the industry in both the number of plant installations, given as 331, and in total capacity, 2,759,000 gallons. The status in Oklahoma is given as follows: 302 operating plants with a total of 2,663,000 gallons daily production. Shut down plants in Oklahoma numbered 29, having a capacity of 96,000 gallons. Oklahoma leads in inoperative plants and capacity, as well as operating plants.

Texas is second in number of operating gasoline plants, having 146 in operation, 11 inoperative, and a total of 157 installations. The daily production of natural gasoline in Texas is given as 1,624,000 gallons.

California is reported third in number of operating plants, giving that number as 141. Total number of plants in California is given at 159, with 18 installations not in operation. Daily production in California is somewhat higher than that of Texas, and not much lower than that of Oklahoma, being reported as 2,099,000 gallons.

While Pennsylvania and West Virginia hold fourth and fifth places, in the number of gasoline plant installations the daily production from those States is much lower than gasoline produced daily in the new districts where much larger installations are in order. Pennsylvania with 138 plants in operation, most of which are small, produces but 122,000 gallons of gasoline daily. West Virginia with 117 plants in operation contributes 384,000 gallons daily to the country's total. In comparison with Pennsylvania for example, the 141 operating plants of California were producing over two million gallons of gasoline daily.

The absorption type of gasoline plant still maintains its lead secured several years ago when this type of installation became popular with operators. Absorption plants numbering 526 produce 5,476,000 gallons of the total. The compression type of gasoline extraction plant numbers 497, but daily production from the compression plant is but 1,398,000 gallons. There are 105 combination compression and absorption plants which produce a total of 960,000 gallons of gasoline daily. The total number of charcoal plant installations, according to the current survey is but 27, and from this source there is but 214,000 gallons of gasoline produced daily. The charcoal type of gasoline plant is, however, operating in a number of gasoline producing areas. Eleven plants produce 100,000 gallons daily in West Virginia. Texas has three charcoal plants, Oklahoma has four, Pennsylvania, three; Ohio, two; Louisiana, two; Kentucky, three; California, one; and Arkansas one. The popularity of the absorption gasoline plant is evident from the survey, especially in the newer producing districts. California operators have 109 absorption plants, Oklahoma 165 and Texas 105.

The number of gasoline plants in this country has increased despite the decline in gasoline prices, the number of operating companies, however, has declined, showing a trend toward concentration or centralization of the industry. The accompanying table shows the status of the industry as of January 1, 1928, taken from the recent Bureau of Mines survey:

RECAPITULATION BY STATES—JANUARY 1, 1928

Number

State—	Operating	Shut Down	Total	Absorption	Compression	Combination	Charcoal
Arkansas	14	4	18	11	3	3	1
California	141	18	159	109	4	45	1
Colorado	1	....	1	1	....	....	....
Illinois	76	2	78	....	78	....	....
Kansas	23	....	23	14	8	1	....
Kentucky	11	1	12	5	4	....	3
Louisiana	45	3	48	30	11	5	2
New Mexico	1	....	1	1	....	....	....
New York	3	1	4	2	1	1	....
Ohio	33	4	37	15	20	....	2
Oklahoma	302	29	331	165	137	29	....
Pennsylvania	138	15	153	20	121	8	4
Texas	146	11	157	105	41	8	3
West Virginia	117	7	124	42	66	5	11
Wyoming	9	....	9	6	3	....	....
Total	1060	95	1155	526	497	105	27

Capacity (thousands of gallons per day)

State—	Operating	Shut Down	Total	Absorption	Compression	Combination	Charcoal
Arkansas	124	9	133	89	4	35	5
California	2099	83	2182	1641	24	460	57
Colorado	1	....	1	1	....	....	....
Illinois	57	1	58	....	58	....	....
Kansas	164	....	164	113	41	10	....
Kentucky	57	1	58	46	7	....	5
Louisiana	262	16	278	214	36	21	7
New Mexico	10	....	10	10	....	....	....
New York	2	1	3	2	1	....	....
Ohio	56	3	59	47	4	....	8
Oklahoma	2663	96	2759	1629	769	361	....
Pennsylvania	122	9	131	55	33	31	12
Texas	1624	53	1677	1331	306	20	20
West Virginia	384	22	405	244	40	22	100
Wyoming	129	....	129	54	75	....	....
Total	7754	294	8048	5476	1398	960	214

H. L. Deming has resigned as refinery general manager of the Lincoln Oil Refining Company, Robinson, Illinois.

PLANT REBUILT

Dixon Creek Oil Company, Borger, Texas, has completed the installation of its new absorption gasoline plant. The company's former installation was destroyed by fire some time ago. The new unit is Southwestern equipment, having a capacity of 18,000 gallons daily.

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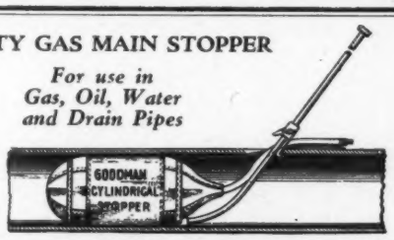

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Abstracts of Technical Literature

Of Particular Interest to the Plant Operator

Emulsified Oils for Machine Tools. Luttringer. (*Mat. grasses* 19, 8040-2 (1927); 20, 8068-70 (1928.)

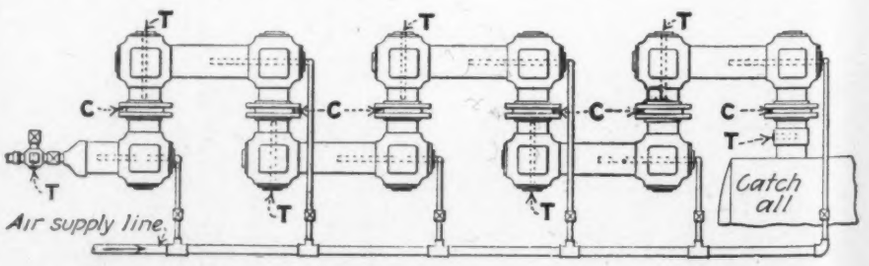
A brief description of the qualities required of such oils, their preparations and analysis.

Protection of Driving Belts with Belt Grease. von. Berge. (*Kunststoffe* 17, 250- (1927). *C. A., Vol.* 22, *No.* 5, *p* 863.)

A number of recipes for belt grease are given.

The Catalytic Oxidation of Oils on a Commercial Scale. Bitler and James. (*Chem. and Met. Eng., Vol* 35, *No.* 3, *p* 156.)

Plant described has a capacity of oxidizing, in the vapor stage, approximately 4000 gallons of kerosene per day, but it can handle also gas oil and spindle oil. The oxidation is carried on in four identical units, each handling 40 gallons of kerosene per hour. The oil first passes through a Venturi type meter with a block tin throat. From the flow-meter the oil passes into a Foster oil heater, which in this case is really a tube still. Here the oil is completely vaporized and superheated to between 350 and 375 degrees C. In the case of heavy distillates steam is admitted to complete the vaporization at this temperature. From the vaporizer the oil passes to the oxidizer, or to prevent the oxidizer from being flooded during heating up it may be bypassed directly to the condenser. The oxidizer is made up almost entirely of standard six-inch pipe and fittings as shown in Figure 1. The nipples between the screens do not present sufficient cooling surface to dissipate the heat of oxidation, so these were equipped with spiral fins. C is a casting which holds the catalyst screen in place. A one-inch valve admits air for the oxidation, the air passing well back into the nipple so that it becomes thoroughly mixed with the oil vapors before passing the catalyst screen. The amount of air admitted is regulated to give a temperature to the vapors after passing the screen of 410 degrees C. If more air is admitted the temperature increases and excessive carbon dioxide formation is observed. Up to this temperature the loss to carbon dioxide does not increase rapidly. With a good catalyst, the oxidation reaction begins as low as 225 degrees C. In practice the oxidizer is preheated by gas to 250 degrees C. and the oil vapors admitted. In four to five minutes the reaction will heat the whole oxidizer to operating temperature. The finned nipples cool the vapors again to 350 degrees and the heat of reaction again brings them back to 410 degrees C. The oxidizers were built for six screens, but it was found necessary to use only four. As far as the catalyst is concerned, cooling between screens could be carried further and more reaction per screen obtained, but the oil vapors would tend to condense at this lower temperature and foul the screens. The oil vapors and the nitrogen from the air then pass through a tank equipped with a sort of reflux condenser made by water jacketing a six-inch pipe, eight feet long. In this tank most of the heavy tars (polymerization products of the unsaturated oxidized bodies) which would foul the condensers are removed. The vapors then pass to an aluminum tubular condenser. Four hundred five-foot tubes ⅝-inch (outside diameter), are used, giving a cooling surface of approximately 330 square feet. The tars that are not caught in the reflux tube foul the condenser, so that it must be cleaned with steam or compressed air about once every two weeks of continuous running. The condensed vapors then pass to a central receiving tank for all four units. There is a bypassing trap in each line for taking samples during the run. The increase in specific gravity of the oil is a rough measure of the per cent of changed molecules in the oil. The main receiving tank is maintained under a 15-inch vacuum by two No. 3 Nash Hytor vacuum pumps. The amount of air consumed is about 160 cubic feet per minute per unit at atmospheric pressure. The uncondensed vapors and nitrogen contain considerable quantities of formic acid, rendering water a poor cooling medium and seal for the pumps. Hence oxidized oil is used for sealing and as a cooling medium. It is trapped from the exhaust gases, passed through a tubular oil cooler and returned to the pumps by their own suction. From the main receiving tank the oil is pumped to a settling tank with 1½-inch Viking pump. This pump gives good service pumping against the 15-inch vacuum in the tank. The settling tank is a large vertical tank 12 feet high and six feet in diameter. It takes about one hour to settle out the water formed in the oxidation.



This is drawn off and the oil pumped to a storage tank for further treatment. At present, the plant is running on a Pennsylvania kerosene and the oxidized product is the material from which the alcohol denaturant known as Aldehol is prepared.

NEW MANUFACTURING METHODS

Lubricating Oils From Coals

(*Nielsen and Baker. Mech. Eng., Vol.* 49, *No.* 10, *Oct.* 1927, *pp.* 1109-10.)

Method of preparation of lubricating oil from coal oil and report of tests of two samples, one distilled from coal and the other a straight mineral oil.

New Uses

Utilization of Light Petroleum and Petroleum Residues. Aschan. (*Chem.-Ztg.* 51, 4 (1927). *C. A., Vol.* 22, *No.* 6, *p.* 1032.)

The light petroleum fraction (boiling 10-70 degrees C.), consisting mainly of pentane and hexane is suitable for use as a selective solvent and precipitant for many compounds, and as a source of derivatives of the lower paraffins. Thus the hydrocarbons can be used by intermediate conversion into their monochloro derivatives and by suitable fractionation, for the production of, for example, amyl alcohols or of technical amyl acetate. The residues boiling at 300 degrees C. obtained from petroleum oils with a high naphthene content, for example, Russian masut, yield on pyrogenic decomposition at 700-800 degrees C., considerable quantities of isoprene, benzene and toluene.

Gases Produced by Cracking Oil for Use in Buoys and Light Ships. Delaplace. (*Compt. rend.* 185, 1469-72, (1927). *C. A. Vol.* 22, *No.* 5, *p.* 860.)

In these gases it is important to eliminate or prevent formation of hydrogen because of the difficulty of compressing it and this is obtained by luquefication and rectification of the crude gas, while in a new French process the crude gas is made to react so as to give saturated hydrocarbons. The composition of the crude and purified gases obtained by these processes is compared to show the superiority of the new process French gas.

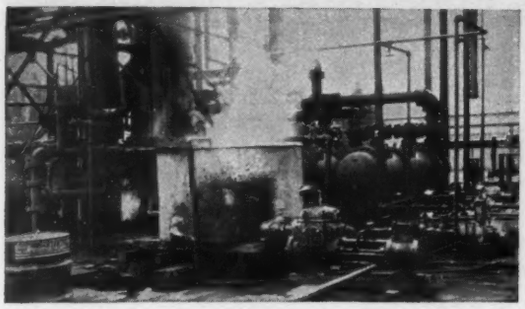
NATURAL GASOLINE INDUSTRY

Natural Gas and the Extraction of Gasoline Therefrom. Brun. (*Rev. chim. ind.*, 36, 400-5 (1027.)

A brief review of the various processes used.

Simplified Calculations in Design of Natural Gasoline Absorbers. Lewis. (*Chem. and Met. Eng., Vol.* 35, *No.* 2, *pp.* 93-95.)

In "Principles of Chemical Engineering," by Walker, Lewis and McAdams, second edition, 1927, McGraw-Hill Book Company, Inc., pp. 675 et seq., is given a method of computation of continuous counter-current absorption systems for the absorption of any single component in a gaseous mixture by a non-volatile liquid absorbent in which the other component or components of the gas are substantially insoluble. The method therein described not only simplifies the computations nec-



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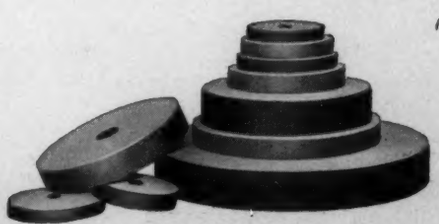

essary in the design of equipment and the testing of operating plants, but makes it easy to visualize what is taking place in the process. In this article the application of the method of computation (already developed) is expanded to solve the more complicated problems met in the absorption of the large number of components present in natural gasoline. By the method of approach described in this article, Lewis states that it is possible to design absorption units for natural gasoline on a rational basis, strictly comparable with the methods used in the less complicated cases with which the chemical engineer is more familiar. Lewis states: "In general, one will design for the recovery of the most volatile component that it is desired to recover in quantity. It will then be necessary to make sure that the recovery of those higher boiling components next in order of volatility is satisfactory, but once this is done there need be no question about the recovery of components of still lower volatility. Furthermore, the amount of absorption of the undesirable, more volatile constituents can be estimated with precision. This makes it possible to design not only an absorption unit, but also the supplementary stripping equipment with a precision and dependability hitherto seldom realized. These methods are also directly applicable to stripping operations, it being kept in mind that the operating lines must be on the opposite side of the equilibrium curve."

OF PARTICULAR INTEREST TO THE PLANT OPERATOR

Treating Emulsions

Providing Chemical Treatment for Petroleum Emulsions. Cuno. (Chem. and Met. Eng., Vol. 35, No. 3, p. 165.)

Petroleum emulsions or "bottom settlings" consist essentially of particles of water dispersed throughout the oil and held in suspension due to substance that acts as an emulsifying agent. This substance is not in true solution, but is colloidal and acts as a protective colloid. Analysis of various oils that produce water-oil emulsions discloses the fact that they carry varying amounts of asphaltic material, while the paraffin-base oils produce no such emulsions. There must be an emulsifying agent present. To produce a "water-in-oil" emulsion there must be an oil "soluble" (strictly speaking, oil wetable or dispersible) agent present. In this case, the asphaltic materials act as such. In the oil industry, four general methods are used for destroying or breaking up these emulsions—heating, electrostatic precipitation, centrifuging and chemical treatment. Bureau of Mines estimates that more than one-fifth of the Mid-Continental oils and at least 25 per cent of the California oils must be thus treated before they are acceptable to pipe line carrier. Quantity of oil treated chemically is believed to be in excess of all other methods. Author then briefly describes Tret-O-Lite principle of treating emulsified oils and the plant of the William S. Barnickel Company at Webster Grove, Missouri.

Cracking

Improved Production of Cracked Gasoline by the Blumner Process. Salmony. (Erdol u Teer, Feb. 25, 1928, p. 91. Libr. Bull., U. O. P. Co., Vol. 3, No. 11, pp. 101-102.)

Dr. Blumner's cracking process, covered by Ger. Pat. No. 338864, 1922, is similarly protected by patents in all the civilized states in the world. Its distinctive feature is the heating of the oil to cracking temperature by passing it at a pressure of 35-40 atmos. through an autoclave containing molten lead in which Raschig rings are immersed. This avoids coking and gives a yield up to 80 per cent of the raw gasoline. The process is of course continuous and smaller heating surface is required than in the pipe still.

The incoming crude oil is mixed with hot residuum at 220 degrees C. and the mixture at about 100 degrees C. is pumped to the preheater, which is heated by flue gases. At about 250-300 degrees C. it is forced into the autoclave where it is brought to 450 degrees C. (842 degrees F.) and then goes on to the reaction chamber for the completion of cracking. The reaction chamber is well insulated, but it is not heated. The cracked vapors pass through the automatic pressure-relief valves into the separator which is held at about 300 degrees C. by hot gases. The heavy oil and pitch are drawn off, the light oil passes to the air condenser. From here the run-back returns to the heat exchanger, and the light vapors pass through column, dephlegmator and condenser.

Paraffinic oils and distillates give the best yields; smaller yields are recorded for brown-coal tars and coal tars. The paraffin-base oils give little gas; the unsaturated, asphaltic stocks, large amounts. By the use of active carbon the cracked gases can be made to yield from 50 to 100 kg. of very high gravity gasoline per 100 cu. m. For a large installation, with a throughput of 30-50 tons per day, a foreman and two workmen are sufficient. The smallest unit practicable yields 15 tons of gasoline and corresponds to 20-30 tons of charging stock. Double units produce 30 tons from 50 tons of charging stock. These cost, respectively, 175,000-300,000 reichsmarks to install. The following are typical yields:

1. From paraffin-base or asphalt-poor lighter oils or distillates:

Raw gasoline about 80% or refined	70%
Gas	7%
Residuum or heavy oil	20%
Loss	3%
	100%

11. Asphaltic crudes, and brown-coal and light shale oils:

Refined gasoline	50- 60%
Gas	12- 10%
Asphaltic residuum	32- 24%
Loss	6- 6%
	100-100%

111. Brown coal generator tar, primary tar, heavy coal tar, and shale oils:

Refined gasoline	35-50%
Gas	25-12%
Asphaltic residue, including phenol	40-25%
Loss	10-13%

Coal tar contains too much oxygen and not enough of the compounds suitable for cracking to be used as charging stock.

Treating

The Acid-Sludge Problem in Oil Refining. Rather. (New York Meeting A. I. M. M. E., Feb. 1928, Libr. Bull., U. O. P. Co., Vol. 3, No. 10, pp. 95-96.)

As early as 1859, the year of the discovery of the Drake well, a patent was issued for separating sludge from acid and concentrating the acid. Patents issued to Loftus in 1864, to Penissant in 1878, and to Farrar and Gill in 1878 were, like the earlier one, based on the procedure of diluting, agitating, and settling. This also forms the basis of later inventions looking to the same end. Van Tienen (1911) applied both heat and pressure. He diluted the acid with water to about 52 degrees Baume and heated the mixture to 140-165 degrees C. (284-329 degrees F.) at a pressure of about 100 pounds per square inch. The liquid separated into two layers, acid and tar. The procedure with sludge from paraffin lubricants has been and still is, in some circumstances, to cook the sludge for several hours with open steam, without first diluting. Three layers form, acid of about 45 degrees Baume, pitch, and acid oil. The pitch is converted to coke-like lumps by being fed to a screw conveyor and sprinkled with cold salt or fresh water. The corrosive action of such fuel is sometimes corrected by adding alkali after separating the weak acid. This fuel can be pumped, but must sometimes be diluted with gas oil.

The earlier separators were only tanks with means for agitating and for drawing off the separated liquids. For heavy sludges this is not sufficient and it is necessary to introduce open steam pipes. Sludges from treating naphthene-base kerosene with fuming acid require long cooking with steam. Continuous separators were first evolved in 1926. In refineries where both light-oil and lubricating-oil sludges are produced, these may be mixed before the acid separation and the mixture is then fluxed with heavy fuel oil.

No very satisfactory method of concentrating the acid was found until the Chemico process was applied, first in 1920. This removes the water by bubbling hot air and flue gases through. Heat transfer is better, temperature required and fuel costs are lower, risks, repairs, and losses are reduced; so that total operating costs are only 50 per cent of what they are with the pan concentration system. The Simonson-Mantius process makes use of vacuum distillation. These are two-stage processes. The Geyser, a one-stage process, consists in blowing hot flue gases across the surface of the liquid, which is kept thoroughly agitated by a current of air.

Where sludges cannot well be fluxed they are most easily burned by reducing

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to coke, and vice versa. It was observed in an Eastern refinery where heavy sludges from the treatment of crudes for producing cylinder stock were to be burned that the separated and fluxed sludge could be pumped the 1000 feet to the boiler house if treated within 24 hours after it was produced; if allowed to "ripen," it could hardly be separated from the acid or fluxed.

The scrubbing of the fumes from acid concentrators, to remove sulfur dioxide, their precipitation by the Cottrell electric precipitator, and the practice of conveying them to a high stack are three of the methods of disposing of the sulfur dioxide nuisance.

Safety Measures

Prevention of Hydrogen Sulfide Poisoning in Handling and Refining High-Sulfur Petroleum. Fowler. (Bur. Mines, Reports of Investigations No. 2847.)

A good summary of the present state of knowledge dealing with high-sulfur crudes. The various methods of protection against hydrogen sulfide are reviewed and precautionary measures are outlined for cases where it is necessary to expose men to this gas.

OF PARTICULAR INTEREST TO THE REFINERY AND CHEMICAL ENGINEER

The Role of the Combustion Engineer in Refining. Hays. (Mining and Metallurgy. Vol. 9, No. 255, pp. 126-128.)

In oil refining greatest heat losses occur during the cooling operation, but there are losses (many of them preventable, either wholly or partly) at every step of the several processes in refining. Function of combustion engineering department is to check all processes to detect wastes, have charge of all tests, except those properly coming within the province of the laboratories, and to do such research work as may be permitted in the development of improvements in heat processes. The combustion engineer and his department should not be under the jurisdiction of any refinery head. This is on the sound theory that the men who are doing the checking should not be under the control of the men who are being checked. The department should be under the control of the highest official responsible for the refinery and should take orders from no one else. Whatever the department gathers in the way of information likely to prove useful to the mechanical and process departments and, above all, to the superintendent of the refinery, must be open and available to them at all times. The combustion engineer must work out some general and comprehensive plan of campaign for his department. His job is:

1. To find out what should be done, where, when, and how to do it. His previous experience will indicate, in a general way, his points of attack.
2. To get authority to have it done.
3. To get it done. Someone has said that plan is 10 per cent and execution 90 per cent.
4. To keep it done. It is one thing to get efficiency and another thing to maintain it.

Author then elaborates upon methods of carrying out plans.

Boilers and Boiler-Houses: Construction and Operation

Modern Boilers, Their Design and Construction—Methods of Increasing Power-Plant Efficiency. Fish. (Steam Coal Buyer, Vol. 8, No. 5, Nov. 1927, pp. 38-41.)

How boilers are made to stand present high pressures; great demand for new boilers of large sizes; water walls are necessary; chimney losses are reduced; superheaters used, necessary to select right equipment for case at hand.

Condenser Design and Construction Progress. Orrok. (Power Plant Eng., Vol. 32, No. 1, Jan. 1, 1928, pp. 55-56.)

Decreased surface and high heat transfer are results of improved design of condensers and auxiliaries; water-side problems remain to be solved.

Modern Boiler Room Control. Drabelle. (Power Plant Eng., Vol. 32, No. 1, Jan. 1, 1928, pp. 34-35.)

Automatic control as applied in modern plants; it is function of automatic boiler-control equipment to duplicate as closely as possible results obtained under test conditions.

Measuring and Recording the Flow of Steam. (Power Plant Eng., Vol. 32, No. 1, Jan. 1, 1928, pp. 46-49.)

Flow meters consist of primary element acted on by fluid and secondary element

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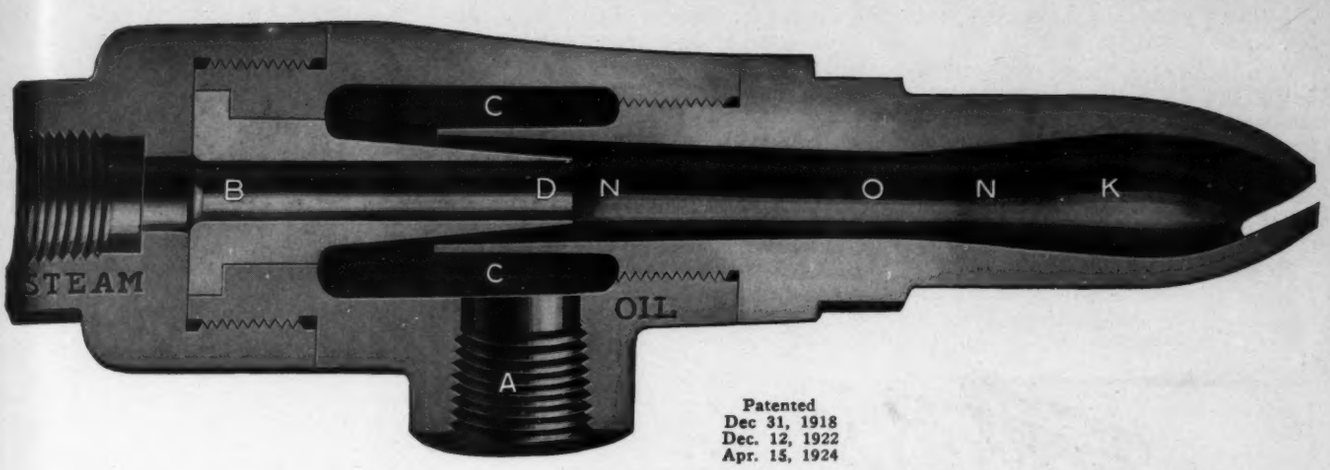

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transforming action of primary element into indication or record of amount of flow; flow-nozzles; thin-plate orifice; fundamental equation of flow.

Condensate Handling Presents Many Problems. (*Power Plant Eng., Vol.* 32, *No.* 1, *Jan.* 1, 1928, *pp.* 62-64.)

With surface condensers return of condensed steam to boiler-feed system offers many possibilities which should be analyzed; one method of measurement which offers no possibility of argument is direct measurement of weight with calibrated scales.

Internal Corrosion of Fuel Economizers. Ingham (*Mech. World, Vol.* 82, *No.* 2138, *Dec.* 23, 1927, *p.* 467.)

Corrosion caused by pure water is generally believed to be due to presence in water of dissolved gases, oxygen or carbonic acid; corrosion may be avoided by using pure water entirely free from dissolved gases; a great deal may be done to prevent corrosion due to presence of dissolved gases in feed water by introducing with feed certain reagents; remarks are confined to ordinary cast-iron economizer.

Combustion of Liquid Fuels

(*Allcut. Power House, Vol.* 21, *Aug.* 20, 1927, *pp.* 13-14.)

Liquid fuel is practically 100 per cent volatile matter, problem of combustion depending on three factors—time, space and opportunity; in all cases, turbulence is a very considerable factor, increasing possibility of speeding combustion.

Low-Pressure Fuel-Oil Burning Systems

(*Schultz. Indus. Mgmt., Vol.* 74, *No.* 5, *Nov.* 1927, *pp.* 263-269.)

Practical suggestions for better efficiency; types of systems and their merits; fuel-oil specifications vs. system; location of pumps, blowers, etc.

Testing Treated Feedwater. (*Power Plant Eng., Vol.* 32, *No.* 1, *Jan.* 1, 1928, *pp.* 30-31.)

Regular routine tests are made and records kept as guide to operation; titration provides simple method; control of blowdown secured by tests.

Treat Feedwater for Its Specific Duty. (*Power Plant Eng., Vol.* 32, *No.* 1, *Jan.* 1, 1928, *pp.* 27-30.)

It is claimed that treatment methods should be individually determined; factors involved in choice of filter; concentration control; corrosive action reduced by degasification.

Purification and Treatment of Feedwater. (*Power Plant Eng., Vol.* 32, *No.* 1, *Jan.* 1, 1928, *pp.* 24-26.)

Present tendencies in methods of testing feedwaters and their subsequent purification and treatment for use in modern power-plant boilers are toward combination of systems; continuous blowdown methods and adoption of zeolite process increasing in use; electrolytic methods have possibilities.

A Method of Feedwater Treatment. (*Gas Engr., Vol.* 43, *No.* 620, *Dec.* 1927, *pp.* 323-24.)

Non-chemical method called "Filtrator" system used at Weston-super-Mare, England; introduces small stream of colloid substances into feedwater or boiler; source of "Colloid" is commercial uncrushed linseed; cost is very small compared to water-softening plant, and effect is just as good.

OF PARTICULAR INTEREST TO THE CHEMIST

Testing and Analysis

Complete Gas Analysis by the Simultaneous Oxidation of Methane, Carbon Monoxide and Hydrogen. von Jueptner. (*Instruments, Vol.* 1, *No.* 1, *pp.* 55-57.)

Complete analyses of gas containing oxygen, nitrogen, hydrogen, carbon monoxide, carbon dioxide, methane and heavy hydrocarbons involve many difficulties. The method recommended by the author is that of Dr. Kress, which carries out the simultaneous combustion of hydrogen, carbon monoxide and methane in a water-cooled explosion pipette after the carbon dioxide, heavy hydrocarbons and oxygen have been removed in absorption pipettes. An illustration gives the necessary calculations.

Detection of Sulfur in Petroleum and Petroleum Distillates. Lane and Devine. (*Bur. of Mines, Reports of Investigations. No.* 2828.)

A modification of Lassaigne's sodium-

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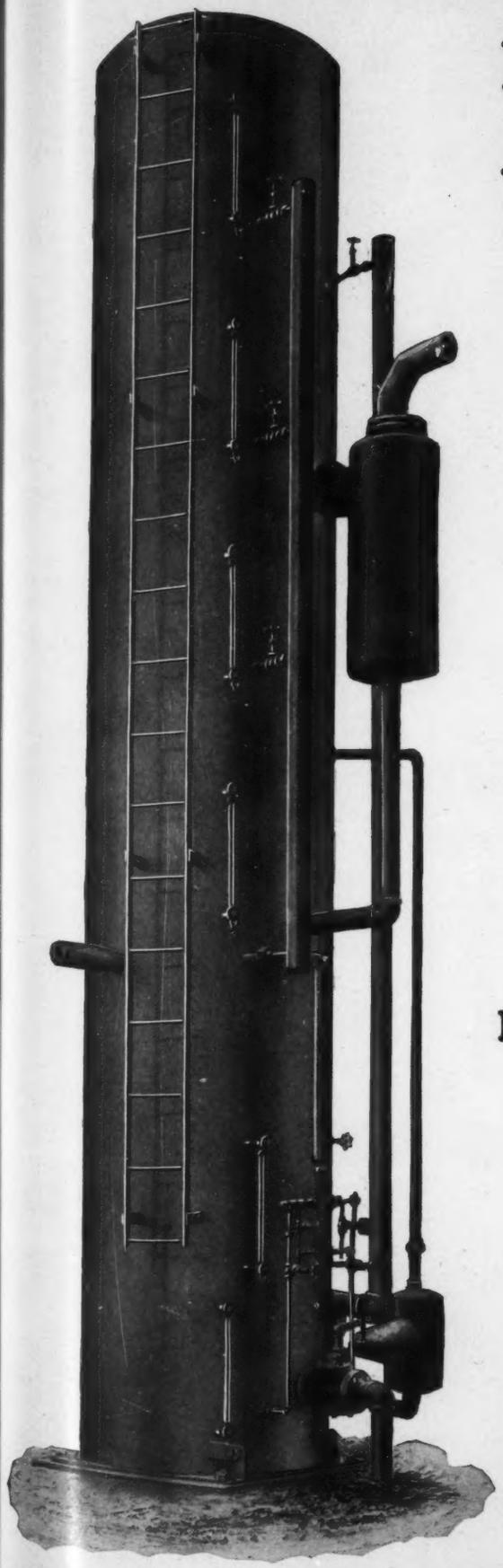

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fusion method using lead acetate instead of sodium-nitroprusside. The method is sensitive down to sulfur concentrations of only 0.02 to 0.03 per cent.

Results of Research and Experimental Work

Burning Tests of Kerosene. (*Thomas. J. I. P. T.*, 13, 402 (1927). *B. C. A.-B., Sept.* 2, 1927, *p.* 643.)

In the author's tests 900 c.c. of oil are fed to a special lamp and burnt by means of a flat wick ¾-inch wide, the test continuing without attention to the lamp after the first hour, for 24 hours. Flame dimensions are adjusted to one-inch wide. The fall in candle power is observed, together with oil consumption, amount and type of film on the glass, and condition of the wick. The normal consumption is 27 c.c. per hour. The lamp gives between 5 and 6.5 candle power.

Comparison of Oils Derived from Coal and from Oil Shale. Horne and Bauer. (*Bur. Mines, Reports of Investigations No.* 2832.)

The average tar yield from 14 lignites was five gallons per ton and from 16 subbituminous coals was 12.9 gallons. Distillates from shales averaged 17.3 gallons per ton, average specific gravity of tars from coals, 1.009. Tars from 10 shales had an average specific gravity of 0.907. On distillation to 275 degrees C., the coal tars gave 45 per cent of light oil containing 65 per cent absorbable by sulfuric acid. The corresponding figure for shale oils was 40 per cent.

Intermediate Base Crude Oil. Smith (*Bur. Mines, Reports of Investigations No.* 2837.)

Two distinct groups of oils are present in the lubricating stock of Salt Creek petroleum; one relatively insoluble in acetone, having low viscosity-gravity ratios, low C-H ratios, and relatively low unsaturation; the other group showing in contrast good solubility in acetone, having high viscosity and C-H ratios, and considerable apparent unsaturation.

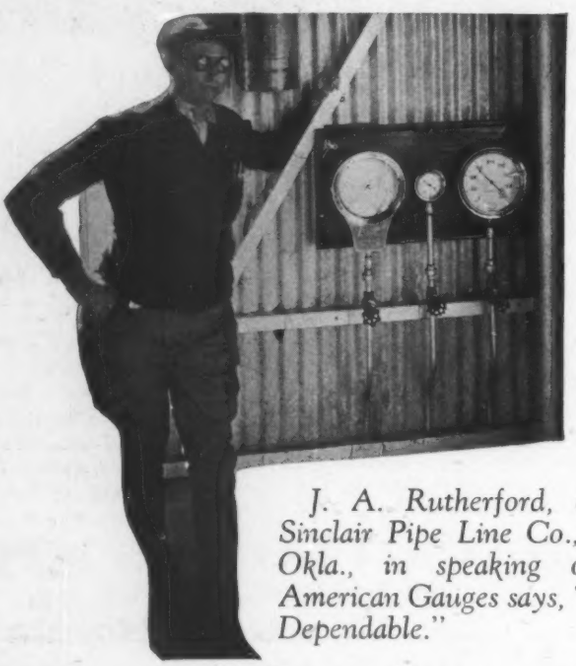
MANUFACTURE OF SPECIFIC PRODUCTS

The production of Turbine Oils

(*V. Vlassenko. Neftyanoe Khozyaistvo* 10, 243-4; *Chem. Zentr.* 1926, *II*, 306. *C. A., Nov.* 10, 1927, *p.* 3738.)

Directions are given for the production of turbine oils T and L from machine oil and spindle oil, and the production of turbine oil M. by mixing T and L grades. With these methods, decolorizing powders are unnecessary.

"They're dependable"



J. A. Rutherford, engineer, Sinclair Pipe Line Co., Stroud, Okla., in speaking of these American Gauges says, "They're Dependable."

The engineer prefers American Gauges and Thermometers because he knows he can rely upon their long service and constant accuracy.

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WEST TEXAS PLANT

Tulsa.—A 2000-barrel capacity refinery is being built by R. S. Allen and associates about one mile west of Pampa, Texas, in section 127, block 3, of Gray County. The plant is expected to be completed about June 1.

William Cerighino, formerly of the Los Angeles refinery of the Union Oil Company of California, is now superintendent of the McMillan Oil Company plant at Borger, Texas.

NEW ABSORPTION PLANT

Fort Worth.—A 20,000-gallon natural gasoline plant, employing the absorption method, is being erected by the Coltexo Corporation, a subsidiary of the Columbia Carbon Company, at Lefors, Gray County, Texas, its location being favorable for obtaining a supply of rich gas.

CARBON BLACK PLANT

Borger, Texas.—The Kosmos Carbon Company's carbon-black plant here is now burning about 10,000,000 cubic feet of gas daily, the third unit of the plant having been put in operation recently.

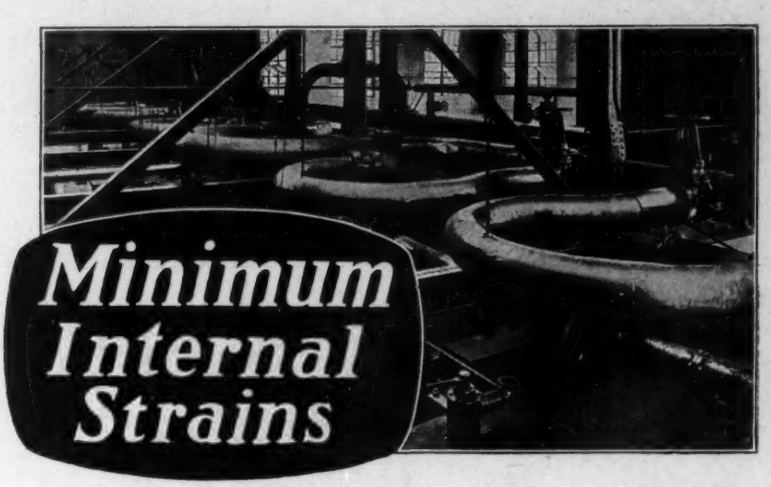
Charles Doughty of the Bossier City refinery is president of the "Loreco" Club, an organization of Louisiana Oil Refining Corporation employees at Shreveport.

J. R. Arrington of the Tulsa office of the Pierce Petroleum Corporation has been placed in charge of all carload sales from that company's refinery at Sand Springs, Oklahoma, the former policy of handling those sales from the St. Louis offices having been abandoned.

Use More Seamless Steel Tubing

Here are *Eight Reasons Why*

***Reason Number* 6**



The eight reasons are—

1. **Steel of any desired analysis**
2. **Uniform texture of the metal**
3. **No weld**
4. **Maximum strength**
5. **No weak spots**
6. **Minimum internal strains**
7. **Longer life**
8. **Safety**

Each of these eight reasons will be the subject of an individual advertisement.

INTERNAL strains in tubes and pipe are caused by non-uniformity in the texture of the metal. Often bent sections, especially those subjected to changes in temperature, fail because of such strains. Pittsburgh Seamless Tubes and Pipe are made by piercing solid steel billets of open-hearth steel. Our seamless process, by the severe working of the steel billet when it is pierced and rolled, gives a texture to the metal that is uniform throughout the length and circumference of the tube. This texture is similar to the texture of forged steel. Thus internal strains are reduced to a minimum, resulting in a material lengthening of the life, serviceability, and economy of the tubing.

For more than twenty years our entire resources have been focused on one objective—how to make a better seamless tube. Today our methods are the most up to date that engineers and scientists have developed. Due to this carefully concentrated attention on only one type of tubing, we have become the largest company in America devoted exclusively to its manufacture.

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Seamless Steel Tubes are the modern standard for all tubular needs.

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Mention Where You Saw the Advertisement

Recent Refinery Patents

1,667,214. Condensation Product from Olefines and Hydrocarbons of the Naphthalene Series and Process of Making the Same. Richard Michel, Uerdingen-on-the-Rhine, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany, a corporation of Germany. Filed June 21, 1927, Serial No. 200,500, and in Germany Feb. 4, 1926. 7 claims. (Cl. 260—168.)

1. Process which comprises reacting with olefines upon hydrocarbons of the naphthalene series, in the presence of a catalytically active metallic halide, under conditions of elevated temperatures over 50 degrees C. and superatmospheric pressure.

1,667,235. Apparatus for Mixing Sludge. Robert Beattie, Fort Worth, Tex., assignor to Texas Pacific Coal and Oil Company, Fort Worth, Tex., a corporation of Texas. Original application filed June 6, 1927, Serial No. 196,901. Divided and this application filed Nov. 29, 1927. Serial No. 236,556. 7 claims. (Cl. 44—2.)

1. An apparatus of the character described, including a sludge tank, a mixing tank, a mixer, a sludge pump and a second pump for forcing a mixture of liquid hydrocarbons and neutralizing agent, and valve pipes connecting said elements in such manner that the second pump may circulate such mixture through the tank without passing through the mixer, and whereby both pumps may circulate the sludge and mixture through the mixer and mixing tank.

1,666,976. Gasoline Substitute and Process of Making. John B. Neuendorff, San Antonio, Tex. Substitute for application Serial No. 473,382, filed May 18, 1921. This application filed Aug. 6, 1926. Serial No. 127,705. 7 claims. (Cl. 44—9.)

1. A process of improving petroleum distillation for use in internal combustion engines which comprise subjecting the said distillates in a liquid state to the action of clear lime water.

1,667,550. Conversion of Lead Sludge. Joseph Bennett Hill, Philadelphia, Pa., assignor to The Atlantic Refining Company, Philadelphia, Pa., a corporation of Pennsylvania. Filed July 16, 1927. Serial No. 206,253. 4 claims. (Cl. 23—51.)

1. A method of recovering lead compounds from lead sludge, which comprises treating the lead sludge with a solution of an alkali metal hydroxide in the presence of an oxygen-containing gas.

1,667,340. Process of Fractionating Oils. Clive M. Alexander, Tulsa, Okla. Filed Jan. 12, 1926. Serial No. 80,691. 7 claims. (Cl. 196—94.)

5. The process which comprises distilling oil, contacting vapors therefrom with reflux condensate from said vapors having a lower final boiling point than the highest boiling constituent of said vapors that are being contacted, and subsequently contacting the vapors with a higher boiling condensate.

1,667,419. Method of Oxidizing Mineral Hydrocarbons. Joseph Hidy James, Pittsburgh, Pa. Filed Dec. 6, 1921. Serial No. 520,283. 9 claims. (Cl. 196—142.)

1. In the treatment of a liquid mineral hydrocarbon containing hydrocarbons of different molecular weights, the steps consisting of subjecting the same to heat treatment, at least sufficient to convert a part thereof into vapor or gaseous phase, separating from heavier portions thereof a lighter portion in the vapor or gaseous phase, thereafter mixing a lighter portion while still in vapor or gaseous phase with a gas containing oxygen, passing the vapor-oxygen mixture in contact with a catalyst and partially oxidizing the same within a range of temperature below that of continuous self-sustained combustion and which produces partial oxidation products.

1,667,403. Method of Producing Power. Milon J. Trumble, Alhambra, Calif. Filed Oct. 25, 1922. Serial No. 596,725. 3 claims. (Cl. 60—88.)

1. A method of utilizing low grade fuel comprising: placing the fuel in an enclosed chamber; blowing steam through said fuel to vaporize the hydrocarbons contained in said fuel; utilizing said steam and hydrocarbon vapors together in a prime mover; and recovering, by condensation, some of the hydrocarbon values from the exhaust of said prime mover.

1,667,136. Gas and Liquid Contact Apparatus. Clive M. Alexander, Tulsa, Okla. Filed Nov. 27, 1926. Serial No. 151,067. 11 claims. (Cl. 261—114.)

1. An improved bubble tower comprising a vertically arranged container having a series of plates supported therein in spaced relation, said plates being sealed with the walls of the container so as to form a series of compartments intermediate successive plates of the series, means for receiving a liquid at corresponding points in a vertical line on the upper surface of each of said plates and for flowing a stream of the liquid therefrom across each of the plates in the series in the same direction, means for contacting liquid on the surface of said plates with a gas or vapor rising upwardly therethrough, means for returning the liquid in compact streams in free communication with the vapor space of the compartment immediately above each of said plates to a point on said plates near said receiving means and for discharging the liquid therefrom through each of said plates to the receiving

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One Duriron Mixing Nozzle will eliminate six or more orifice plates.

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8" Duriron Mixing Nozzle	300 375 450	5 6½ 8	$36.50

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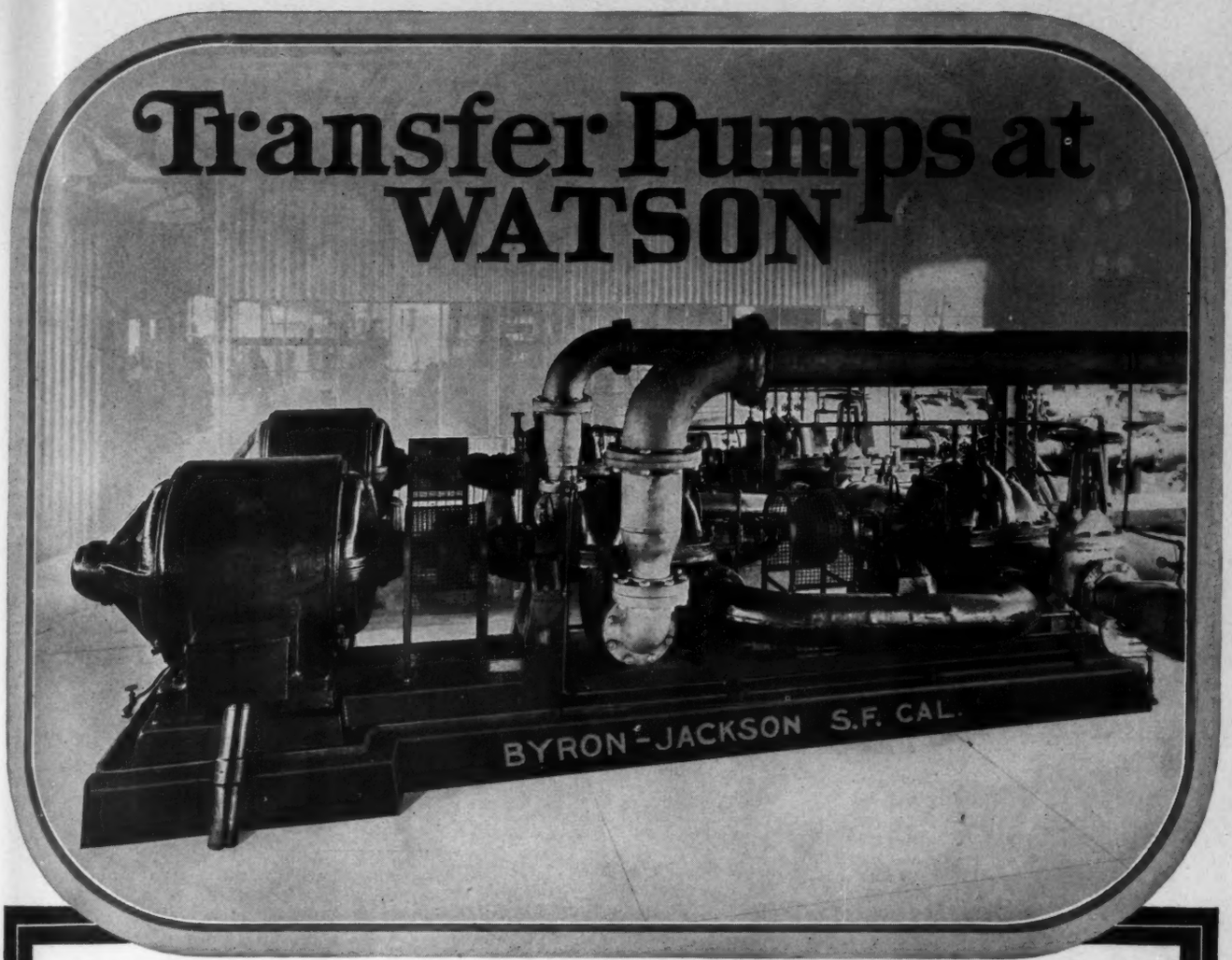

Wherever pumping is done on a large scale, through oil pipe line pumps or in refineries, Byron Jackson Multiplex centrifugal pumps are the invariable preference. At Watson, Byron Jackson centrifugals are everywhere in evidence. This photograph shows them handling gasoline in the ten-mile line to Los Angeles Harbor. Byron Jackson Multiplex pumps are also employed on the 100-mile line from Ventura to Wilmington, the longest natural gasoline line in the world; also in many pipe lines and refineries in various domestic and foreign fields. In the growing dependence placed on Byron Jackson equipment the world over by petroleum engineers is seen the reward of this company's policy in designing durable pumps to meet the needs of the industry.

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One of our spray nozzle cooling systems in operation at an oil refinery in Louisiana

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IF YOU need water cooling equipment at your plant, your problem is not merely one of buying equipment. Instead, it is a problem in investment—how to get the greatest return per dollar expended.

If you invest your money in one of our cooling towers or spray nozzle systems, we guarantee to give you the maximum return on your expenditure. We have made installations in plants where the available funds were limited, and also in plants requiring all the refinements necessary to secure the maximum operating economies. In every case we worked closely with their engineers in designing and adapting our standard equipment to meet their peculiar requirements.

A letter to our nearest office will bring to see you an engineer of experience, a man who is interested in helping you with your water cooling problem, a man who will consider that problem as one in investment in plant equipment.

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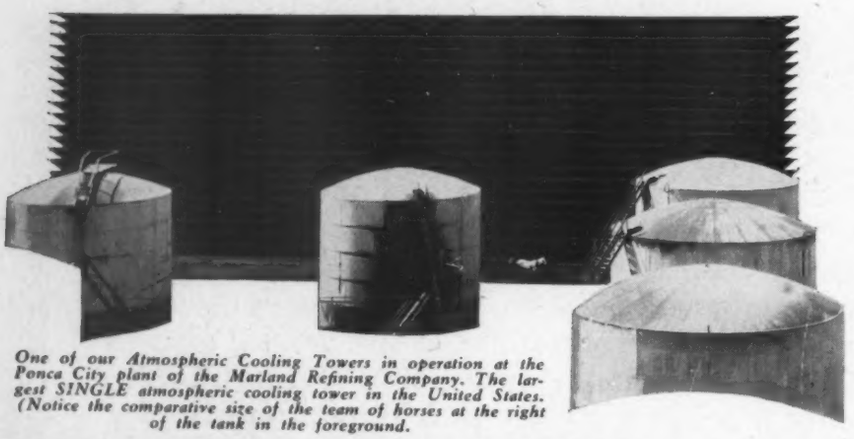

One of our Atmospheric Cooling Towers in operation at the Ponca City plant of the Marland Refining Company. The largest SINGLE atmospheric cooling tower in the United States. (Notice the comparative size of the team of horses at the right of the tank in the foreground.

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That's why Hood's Chemico Spiral Packing Rings have been selected by so many engineers. The center hole prevents choking and clogging.

Made of acid-resisting shale—practically indestructible.

Used by all big producers because of the intensive movements.

Samples on request.

B. MIFFLIN HOOD BRICK CO., Atlanta, Ga.

means for the next lower plate of the series.

1,667,055. Pressure Still. Alfred James Sloan, Kansas City, Kans., assignor to Sinclair Refining Company, Chicago, Ill., a corporation of Maine. Original application filed Sept. 15, 1923, Serial No. 662,797. Divided and this application filed May 18, 1926. Serial No. 109,880. 2 claims. (Cl. 137—53.)

1. An automatic relief valve comprising casing having inlet and outlet openings, a valve seat in the casing adjacent the inlet opening, a valve head fitting the seat to close the inlet opening, a hollow stem attached to the head, a piston on the stem movable in a chamber communicating with the inlet through the stem and operable by the pressure on the inlet side of the head to force the latter toward the seat, and a weighted arm pivoted within the casing and having one end engaging the stem to force the head toward the seat.

1,667,426. Gas-Treating Process. Cornelis Lourens, Amsterdam, Netherlands, assignor to General Norit Company, Limited, Amsterdam, Netherlands, a corporation of the Netherlands. Filed Nov. 11, 1922, Serial No. 600,483, and in the Netherlands Nov. 14, 1921. 1 claim. (Cl. 183—4.)

The process of separating gases which comprises passing the gases through a plurality of containers charged with active carbon and cooling said containers so that the last container is cooled more than the first.

1,667,670. Boiler Compound. William M. Neeley, Amarillo, Tex., assignor to Neeley Chemical Company, Amarillo, Tex., a corporation of Nevada. Filed Dec. 9, 1926. Serial No. 153,732. 1 claim. (Cl. 87—27.)

A boiler compound consisting of one gallon of water glass, one and one-half gallons of caustic soda, one gallon of tannic acid, three gallons of soda ash, and a quantity of water sufficient to make a batch of fifty gallons.

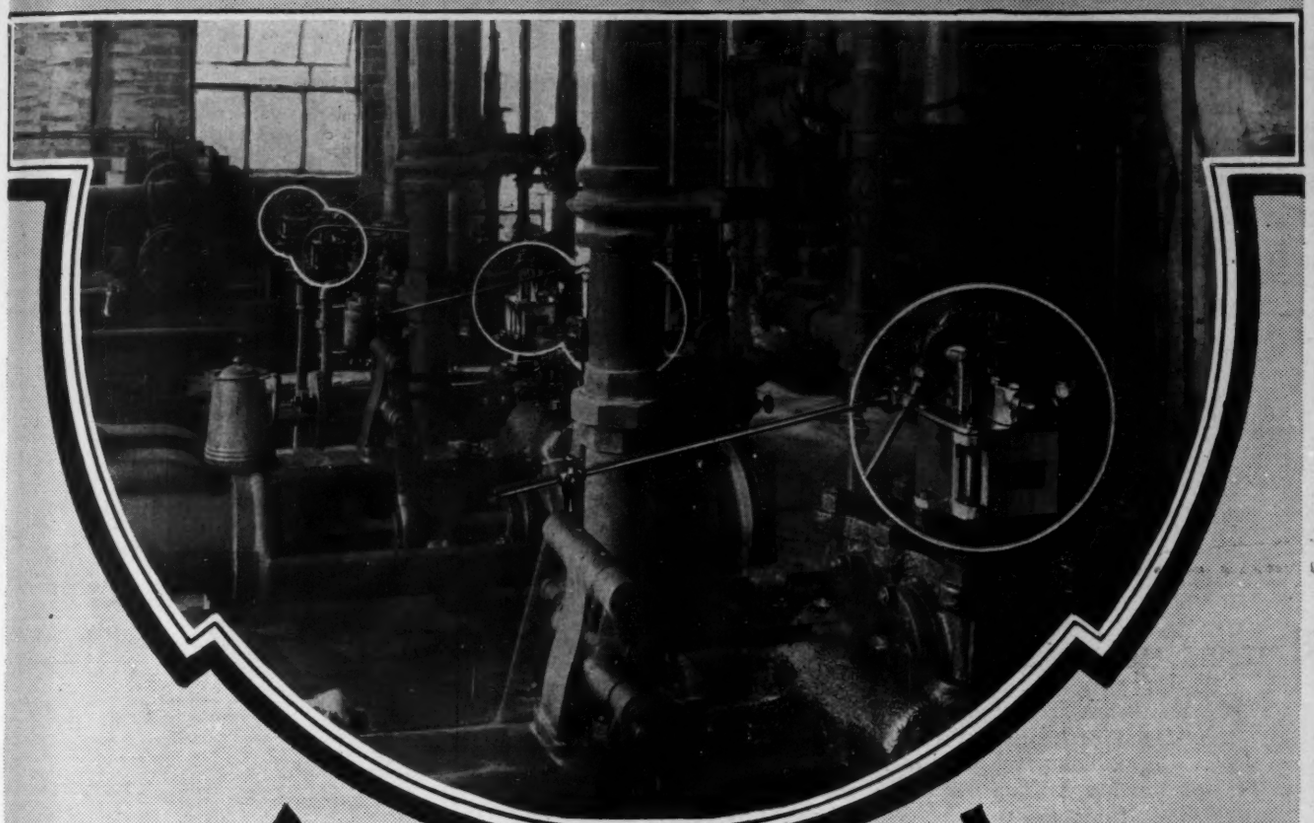
1,666,300. Process and Apparatus for Separating Gasoline from Crude Oil. Arthur E. Pew, Jr., Bryn Mawr, and Henry Thomas, Ridley Park, Pa., assignors to Sun Oil Company, Philadelphia, Pa., a corporation of New Jersey. Filed Feb. 23, 1924. Serial No. 694,471. 9 claims. (Cl. 196—128.)

1. The process of vaporizing mineral oil which comprises heating mineral oil to a distilling temperature and flowing a stream of said hot oil within a still at successively higher elevations and dividing the hot oil flowing at each elevation into confined, multiple, spaced apart streams, flowing mineral oil to be vaporized into the upper part of the still and so disseminating it that it passes into heat exchange relation, but out of contact, with said first mentioned hot oil streams and distributes itself in thin films in heat exchange relation with successively lower oil streams and with progressively hotter multiple oil streams at successively lower elevations so as to produce an intensive heating action and progressive fractional vaporization as well as the substantially complete vaporization of fractions having boiling points below the progressively rising temperatures to which the downflowing distributed and disseminated oil is subjected.

1,666,301. Process and Apparatus for Distilling Mineral Oil. Arthur E. Pew, Jr., Bryn Mawr, and Henry Thomas, Ridley Park, Pa., assignors to Sun Oil Company, Philadelphia, Pa., a corporation of New Jersey. Filed Feb. 23, 1924. Serial No. 694,472. 7 claims. (Cl. 196—128.)

5. The process of vaporizing mineral oil which comprises heating oil to a temperature required to vaporize the heaviest constituents that it is desired to vaporize, flowing a stream of such hot oil toward a vaporizing chamber, dividing said stream into a multitude of fine streams and flowing said streams in multiple in confined spaced-apart paths repeatedly through said vaporizing chamber and at successively higher elevations, consolidating the multitude of fine streams after they flow through said vaporizing chamber at one elevation and before they flow through the vapor-

FORCE FEED Lubricators



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TEXAS FIRE BRICK

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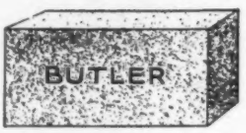
A High Quality Fire Brick Meeting the Needs of Refiners at a Lower Cost



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KERLOW STEEL FLOORING COMPANY
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izing chamber at a higher elevation, and after the oil has so flowed through the vaporizing chamber at the highest elevation again consolidating the flowing oil and allowing it to flow downward through said vaporizing chamber and so disseminating it in its downward flow that it passes into heat-exchange relation, but out of contact, with said multiple hot oil streams and distributes itself in thin films in heat-exchange relation with successively hotter oil streams at successively lower elevations so as to produce an intensive heating action and progressive fractional vaporization and the substantially complete vaporization of fractions having boiling points below the progressively rising temperatures to which the downflowing distributed and disseminated oil is subjected.

1,666,302. Process and Apparatus for Distilling Mineral Oil. Arthur E. Pew, Jr., Bryn Mawr, and Henry Thomas, Ridley Park, Pa., assignors to Sun Oil Company, Philadelphia, Pa., a corporation of New Jersey. Filed Feb. 23, 1924. Serial No. 694,473. 4 claims. (Cl. 196—128.)

3. The process of vaporizing mineral oil which comprises heating a mineral oil to a distilling temperature of the oil to be vaporized and flowing a stream of said hot oil within a still at successively higher elevations and dividing the hot oil flowing at each elevation into confined, multiple, spaced-apart streams, flowing an independent stream of mineral oil to be vaporized into the upper part of the still and so disseminating it that it passes into heat exchange relation, but out of contact with said hot oil streams and distributes itself in thin films in heat exchange relation with successively lower oil streams and with progressively hotter multiple oil streams at successively lower elevations so as to produce an intensive heating action and progressive fractional vaporization as well as the substantially complete vaporization of fractions having boiling points below the progressively rising temperatures to which the downflowing distributed and disseminated oil is subjected, and reheating the cooled oil of the first stream after it flows out of heat exchange relation with the oil of the second stream and recirculating it as hereinbefore specified.

1,666,667. Oil Tank. Joseph N. Pew, Jr., Ardmore, Pa., assignor to Sun Oil Company, Philadelphia, Pa., a corporation of New Jersey. Filed June 8, 1926. Serial No. 114,418. 6 claims. (Cl. 220—26.)

5. An oil tank comprising an outer wall and a roof, one section of which is movable vertically and another surrounding section of which is relatively fixed, the movable roof section carrying a depending cylindrical wall, and means allowing circulation of gas between the gas spaces under the two roof sections.

1,666,693. Composition to be Used in Connection with Anti-Knock Compounds. Wilhelm Gaus, Ludwigshafen-on-the-Rhine, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany. Filed Apr. 17, 1925. Serial No. 23,960. 5 claims. (Cl. 44—9.)

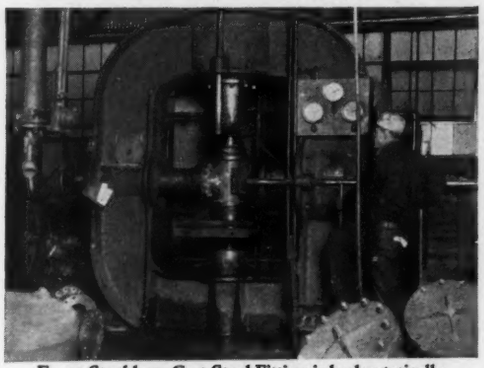
1. A composition comprising a liquid fuel, that has a metal carbonyl compound mixed therewith, and a compound soluble in the said fuel and containing a halogen.

1,666,560. Method of Refining Heavy Mineral Oils by Means of Sulphur Dioxide in a Continuous Operation. Lazar Edeleanu, Karl Pfeiffer, Karl Gress and Paul Jodeck, Berlin, Germany. Filed June 25, 1927, Serial No. 201,474, and in Germany June 12, 1924. 3 claims. (Cl. 196—37.)

1. In a process for refining heavy mineral oils by means of sulphur dioxide in continuous operation; preparing an intimate mixture of the oil and the sulphur dioxide in a vessel by means of a churning device, continuously supplying the mixture to a settling receptacle with a successively decreasing speed and at a zone located about in the midst of the mixture already contained in said receptacle.

1,666,119. Process for Converting Petroleum Hydrocarbons. Walter M. Cross, Kansas

~ For Oil Production and Refining ~
YOUR Fitting Specifications
are met by STOCKHAM



Every Stockham Cast Steel Fitting is hydrostatically tested before shipment

MEASURE the qualities of Stockham Fittings against your specifications to meet the special requirements for oil production and refining service and you'll find they check on every count.

Cast Steel Flanged Fittings and Flanges. Conform to the American Standard. Walls are 3/16" in excess of American Standard Requirements. Regular in outline; conformity to patterns; ample fillets well rounded. Meet specifications of the American Society for Testing Materials. Chemical and physical tests from raw metal to casting insure the strength and soundness of Stockham Steel which is made by the electric furnace method. Free from impurities; never "doctored" in the ladle; no shrinkage; free from sand holes, blow holes, inclusions and cracks. Every fitting hydrostatically tested before shipment. Exceptionally smooth inner and outer surfaces; accurate facings and fine appearance. Made for pressures of 150, 300, 400, 600, 900 and 1350 lbs. and for temperatures according to the American Standard.

Cast Steel Screwed Fittings. Every needed design and size. Same quality standard as Flanged Fittings and Flanges. Accurate threads, accurate alignment, smooth inner surfaces. Strength far in excess of probable strain.

Cast Iron Fittings. Screwed—Flanged—Drainage. Made according to the American Standard. Accuracy in pattern, accuracy in proportioning materials, accuracy in melting, accuracy in molding, accuracy in finishing, accuracy in inspecting and testing.

Oil Country Malleables. Made from special patterns in every size, to particularly meet oil field requirements—these heavy malleables are annealed under definite temperature control, which gives ductility, uniform structure and high strength with great resistance to shock and strain.

Malleables. Regular and Extra Heavy. All Stockham Malleables are made according to the same quality standard which distinguishes all Stockham Fittings.

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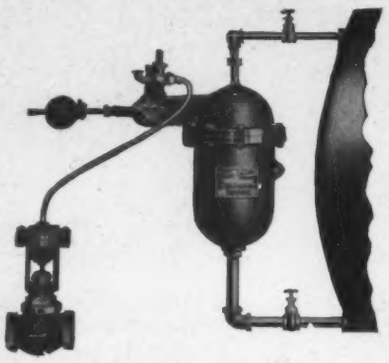
THE VIGILANT OIL LEVEL REGULATOR

for any type of absorber or steam still.



In the process of manufacture of gasoline by absorbing the gasoline in oil and subsequently separating the gasoline from the oil by distillation, it is essential that a constant oil level in both the absorbing tank and the still be maintained.

For this purpose the Vigilant Oil Level Regulator is manufactured. It is adaptable to any type of absorber or steam still and will maintain a constant oil level under all conditions of temperature and pressure.

For 25 years Chaplin-Fulton equipment has been recognized for accuracy and reliability

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Houston, Texas

City, Mo. Filed July 20, 1925. Serial No. 44,781. 3 claims. (Cl. 196—73.)

1. A process of distilling petroleum hydrocarbons, comprising the steps of heating the oil in a preliminary heating stage to a temperature to vaporize the lighter hydrocarbons, passing said heated oil to a vaporizing stage and there separating the liquid and volatilized material, returning the liquid products for further heating to vaporize additional fractions of higher boiling points, and passing the reheated materials to a separate vaporizing stage and controlling the relative heating to which the charging stock and recycled stock are subjected by limiting the extent of their circulation through the heating zone.

1,666,666. Oil Tank. Joseph N. Pew, Jr., Ardmore, Pa., assignor to Sun Oil Company, Philadelphia, Pa., a corporation of New Jersey. Filed June 8, 1926. Serial No. 114,417. 2 claims. (Cl. 220—85.)

1. Means adapted to store oil and allow "breathing" due to formation and condensation of gas which comprises a tank of relatively large volume adapted to contain the oil, a flexible diaphragm having a substantially semi-spherical shape when distended and when distended having a volume that is small relative to that of the tank, means supporting the periphery of the diaphragm and so positioning the diaphragm as to subject it to oil vapor pressure on one side and atmospheric pressure on the other side, said diaphragm being therefore distensible in one direction away from a plane intersecting its peripheral support upon accumulation of vapor and increase of vapor pressure and being distensible in the other direction upon condensation of vapor and decrease of vapor pressure.

1,666,744. Gas-Absorption Apparatus. Wilbur G. Laird, New York, N. Y., assignor to Henry L. Doherty, New York, N. Y. Original application filed June 24, 1919, Serial No. 306,391. Divided and this application filed Nov. 3, 1920. Serial No. 421,442. 6 claims. (Cl. 261—113.)

1. An apparatus for absorbing gas under pressure in liquids which comprises a horizontal cylindrical container, a perforated substantially horizontal partition in said cylindrical container, means for uniformly feeding liquid at one edge of said partition, means for uniformly removing the liquid from the other edge of the partition, means for introducing gas under the partition and removing gas from above the partition and dams at right angles to the axis of the container dividing the surface of the partition into sections.

1,666,597. Process for Distilling Oils. Audley E. Harnsberger, Columbus, Ohio, assignor to The Pure Oil Company, Chicago, Ill., a corporation of Ohio. Filed Nov. 12, 1926. Serial No. 148,060. 4 claims. (Cl. 196—77.)

1. The method of vacuum distillation of mineral oil, which consists in drawing a quantity of oil without reduction in its total weight through a heated pipe still of progressively increasing cross-sectional pipe area from the inlet to the outlet ends thereof, said increasing pipe area permitting such reduction in back pressure due to pipe friction of the oil and vapors drawn through the still to allow a vacuum carried on the outlet end of the still to penetrate back to the inlet end thereof.

1,666,865. Apparatus for Removing Coke from Stills. Leroy V. Robbins, Baton Rouge, La., assignor to Standard Oil Development Company, a corporation of Delaware. Filed Oct. 18, 1923. Serial No. 669,313. 2 claims. (Cl. 196—91.)

1. Apparatus of the character described, which comprises a still provided with a manhole across the lower segment of one end, a closure therefor, a series of flexibly connected break-out strips each having lateral teeth, a drag having support runners and a back made up of top and bottom I-beam pieces and connecting angle-irons, and a flexible connection between the drag and the end of the series of break-out strips, said manhole being large

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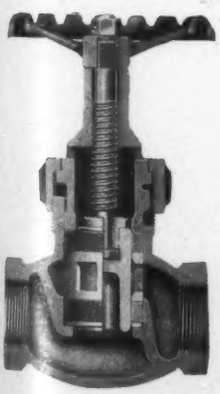

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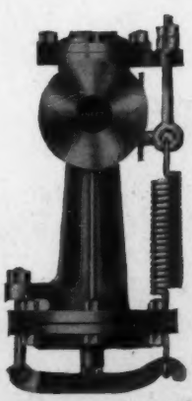

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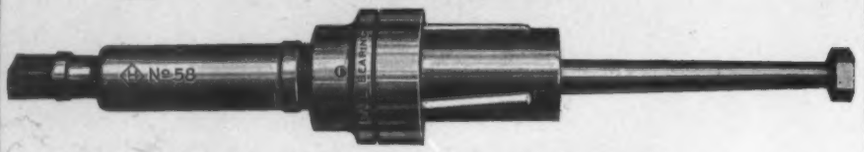

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enough to permit passage of the drag therethrough.

1,665,208. Pipe Joint. Lyman C. Huff, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill., a corporation of South Dakota. Filed June 15, 1925. Serial No. 37,123. 2 claims. (Cl. 288—1.)

1. A joint packing adapted for use in connecting lengths of tubing through which a heated medium is passed comprising relatively movable interengaging annular rings, a corrugated annular gasket enclosing portions of the rings, the corrugations in the gasket being adapted to take up movement of the joint.

1,665,621. Balanced Motor Fuel. Edward F. Chandler, Brooklyn, N. Y. Filed Dec. 23, 1924. Serial No. 757,732. 11 claims. (Cl. 44—9.)

1. A liquid fuel adapted for use in an internal combustion engine, comprising a mixture of a liquid hydrocarbon, an oxide of nitrogen, and a solvent for said oxide.

1,665,264. Silica Gels and Process of Making the Same. Harry N. Holmes and John A. Anderson, Oberlin, Ohio. Filed Aug. 10, 1923. Serial No. 656,716. 7 claims. (Cl. 23—182.)

1. The process of preparing hard silica gel with great porosity, comprising mixing a soluble silicate solution with a solution of a metallic salt to form hydrated silica, a soluble salt, and in insoluble metallic oxide, drying in a manner to produce and preserve in a rigid structure and without material shrinkage the usual ultra-microscopic pores, adding an acid to convert the insoluble metallic oxide into a soluble metallic salt, and washing out soluble metallic and other salts, thereby producing additional pores and increasing the total porosity.

1,666,042. Apparatus for and Process of Distilling Oils. Charles B. Buerger, Pittsburgh, Pa., assignor to Gulf Refining Company, Pittsburgh, Pa., a corporation of Texas. Filed Aug. 28, 1923. Serial No. 659,823. 6 claims. (Cl. 196—126.)

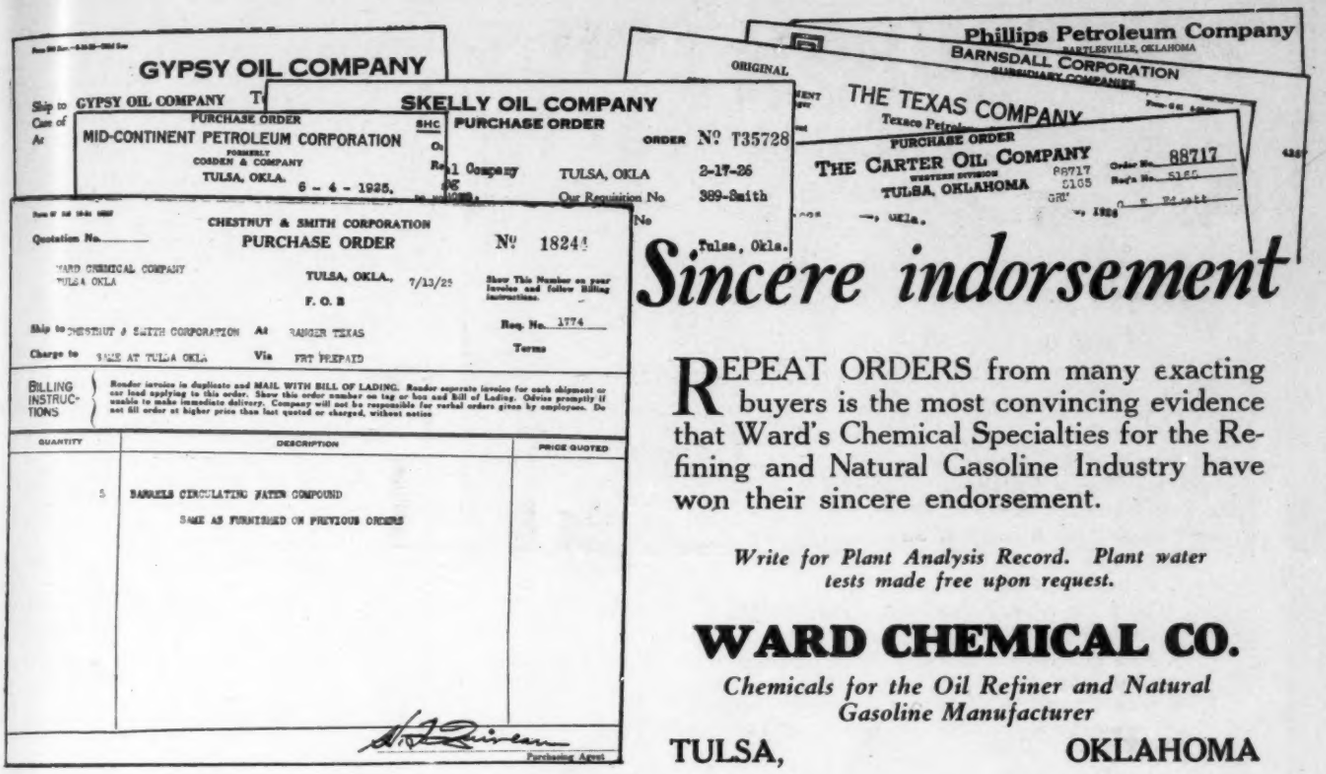
5. In the distillation of oils, the process which comprises forming a plurality of thin annular parallel bodies of oil flowing in a closed ring, the adjacent bodies having a common portion, heating the bodies on one side to cause an upward circulating flow, assisting the flow by applying a jet of steam acting in the same circular direction, and maintaining the rotary flow thus developed in the bodies at substantially the same rate of speed at all portions thereof to prevent the settling of carbon from the oil, and superimposing upon the annular flow a longitudinal flow, whereby all parts of the entire body of oil will be constantly moved at substantially the same speed and without the formation of local portions of relatively quiescent oil.

1,666,051. Process of Distilling Hydrocarbon Oils. William P. Deppe, Brightwaters, and Leland L. Summers, New York, N. Y.; Llewelyn L. B. Summers and Arthur Young, administrators of said Leland L. Summers, deceased. Filed Jan. 5, 1924. Serial No. 684,479. 11 claims. (Cl. 196—73.)

8. The process of distilling crude oils and mixtures of oils with other liquids, which comprises progressively heating and vaporizing the mixed liquids to thereby generate vapors of the constituents at increasing temperatures, keeping the vapors in contact with the liquids while continuously integrating the vapors and liquids and maintaining substantial equilibrium therebetween, then removing the vapors when a predetermined partial pressure of the various vapor constituents is reached at a predetermined temperature, and condensing them.

1,664,963. Liquid Seal. Harold V. Atwell, Whiting, Ind., assignor to Standard Oil Company, Whiting, Ind., a corporation of Indiana. Filed Feb. 14, 1927. Serial No. 168,059. 5 claims. (Cl. 277—45.)

3. A liquid seal comprising a vapor outlet, a liquid channel around said outlet, a pressure plate in said outlet, a liquid channel on said plate, a closing member adapted to cooperate with liquid in said channels to effect closure of the outlet and adapted to be sup-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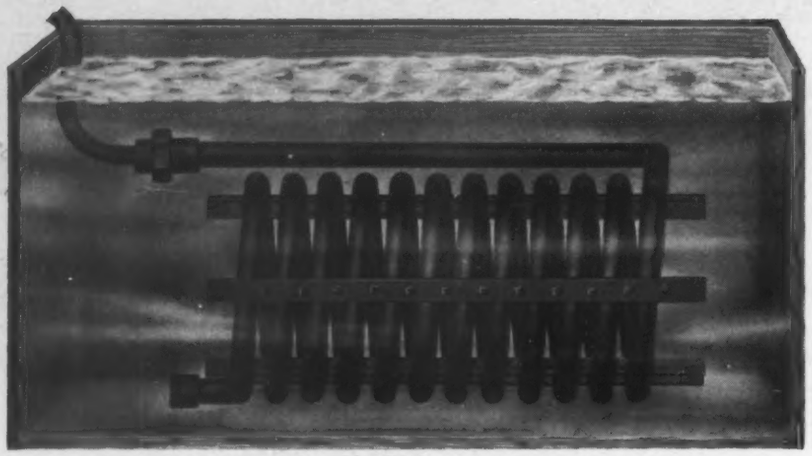

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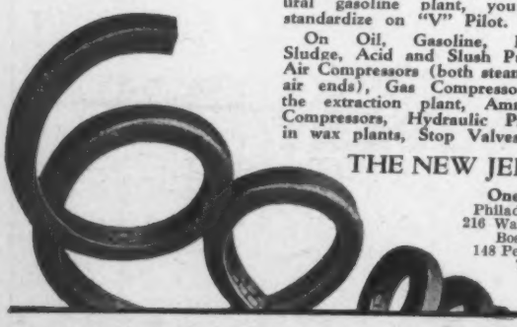

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ported from either of said channels, means for applying an upward force of predetermined magnitude on said plate, so that said member effects closure of the outlet, except when the plate is depressed by a certain excess pressure thereabove or when the plate and member are raised together by a certain excess pressure therebeneath.

5. In combination an outlet passage, a member movable in said passage in opposite directions therein in response to variations in pressure relations on the opposite sides thereof, said movable member being provided with a channel adapted to contain a liquid sealing medium, channel forming means co-operating with the outlet passage to contain a liquid sealing medium, and a closure member co-operating with the channels of the movable member and the channel forming means of the outlet passage to seal the outlet passage, said closure member being movable in one direction with the movable member and being supported in the outlet passage when the movable member is moved in the other direction.

1,664,920. Fire Still and Oil Treater. Forrest E. Gilmore, Los Angeles, Calif., assignor to Forrest E. Gilmore Company, Portland, Oreg., a corporation of Delaware. Filed Feb. 4, 1926. Serial No. 85,852. 7 claims. (Cl. 196—117.)

1. In a fluid heating and separating organization of the general character described: a heater comprising a substantially vertical central flue constituting an inner wall of a chamber to receive the liquid to be treated; a burner near the bottom of said flue; means for introducing said liquid near the bottom of said chamber; and means for conducting the heated liquid from said chamber, at a higher level, to an associated evaporator, said inner wall being provided with outwardly projecting fins, radially disposed in vertical planes to facilitate heat exchange.

1,664,752. Method of Measuring the Density of Gas. Georg Konig, Berlin-Dahlem, Germany. Filed July 3, 1924, Serial No. 723,976, and in Germany Mar. 6. 1920. 7 claims. (Cl. 265—44.)

2. Method of measuring the density of gas comprising, first, imparting kinetic energy to the gas to be measured, second, imparting kinetic energy to a standard gas, third, opposing the force produced by the energy imparted to the gas to be measured to the force produced by the energy imparted to the standard gas, and, fourth, measuring the combined effect of the two opposing forces.

1,664,670. Air Cleaner. Robert R. Dollins, Marland, Okla. Filed May 20, 1926. Serial No. 110,475. 1 claim. (Cl. 183—15.)

As a new product of manufacture, an open top cylinder adapted to contain a predetermined quantity of cleaning liquid, and an insertable unit comprising a cover plate for said cylinder, an air intake and conducting tube depending from said cover plate, an outlet in said cover plate, a deflector cone carried by the outlet in spaced relation, a skeleton supporting structure depending from the cover plate, and screens carried by said supporting structure, one above the other, the lower screen being associated with the inner end of the tube and the upper screen being disposed below the deflector cone.

1,664,493. Valve. Harry F. Smith, Dayton, Ohio, assignor to The Gas Research Company, Dayton, Ohio, a corporation of Ohio. Filed Jan. 27, 1922. Serial No. 532,145. 5 claims. (Cl. 137—53.)

3. A pressure relief valve comprising a casing, a valve member within said casing constructed to normally open under the influence of a predetermined pressure within the said casing, a spring cooperating with said valve for resisting opening movement of said valve member until a predetermined pressure has been reached, means actuated by the pressure within said valve casing for forcing said valve from its seat when a definite pressure in excess of the said predetermined pressure has been

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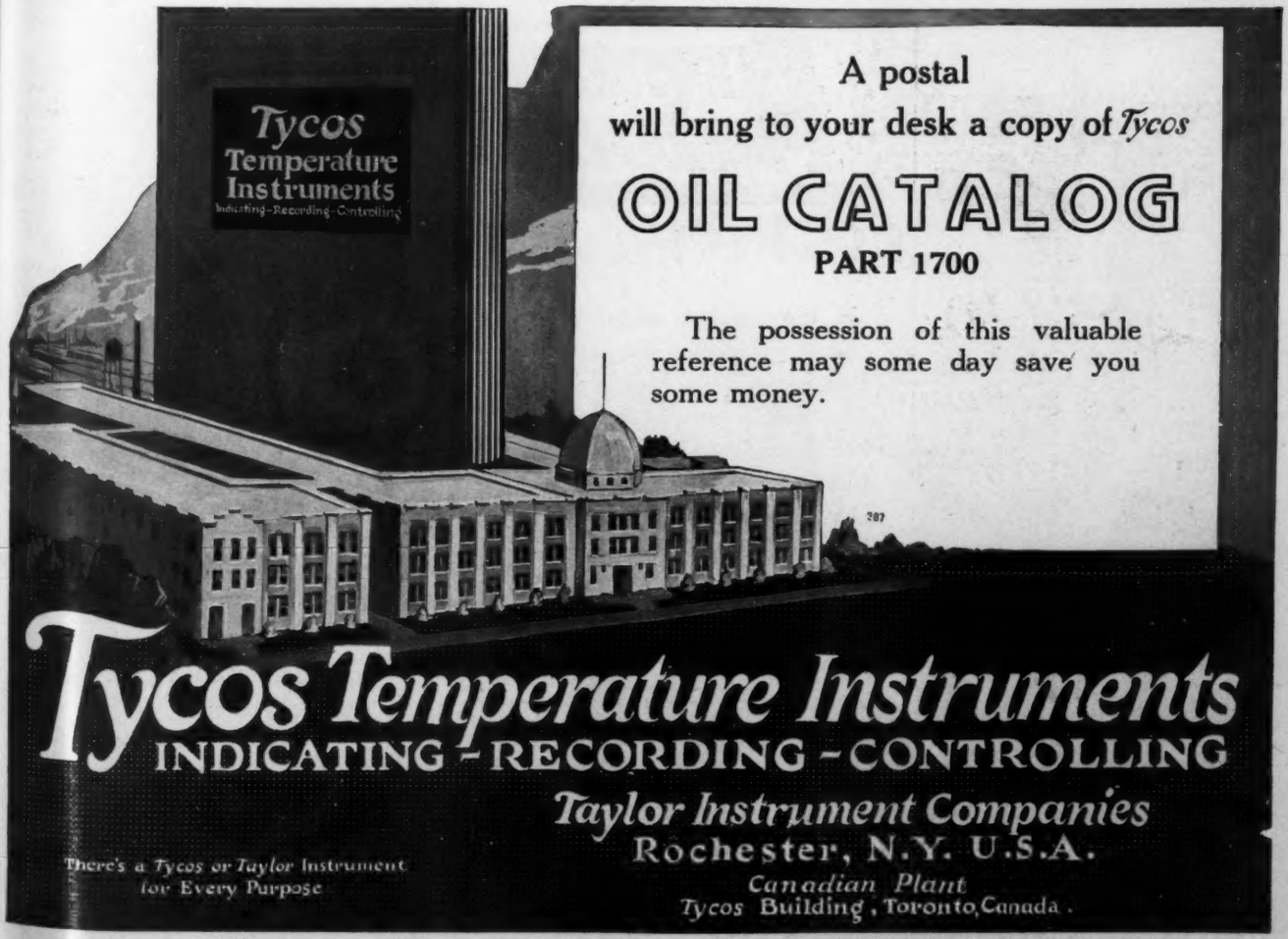

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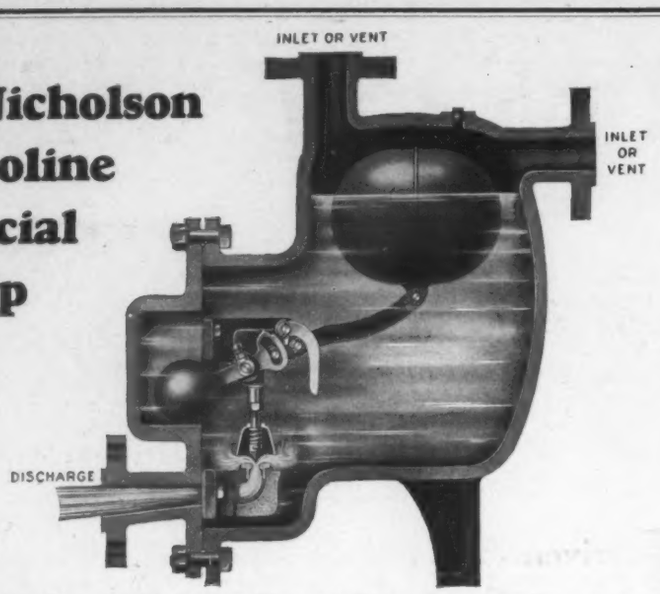

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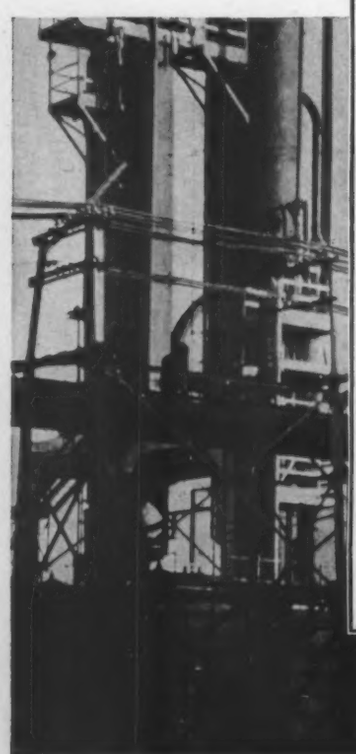

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reached, and means for automatically rendering ineffective said forcing means when the valve member has been opened a predetermined distance.

1,665,164. Apparatus for Separating Liquid Containing a Dispersed Phase of Another Liquid. Earle W. Gard, Long Beach, Blair G. Aldridge, Los Angeles County, and Hugh J. Multer, Huntington Park, Calif. Filed Nov. 16, 1926. Serial No. 148,732. 5 claims. (Cl. 210—43.)

1. An apparatus for separating one liquid dispersed in another, a chamber, an inlet at one end of said chamber and an outlet at the other end of said chamber, a plurality of grids in said chamber, means for attaching a plurality of foraminous plates to said gridwork, a liquid outlet between said grids.

1,665,163. Floating Deck for Oil Tanks or the Like. Charles R. Gallagher, Los Angeles, Calif., assignor to Universal Holding Company, Los Angeles, Calif., a corporation of Delaware. Filed June 12, 1926. Serial No. 115,453. Renewed Oct. 4, 1927. 21 claims. (Cl. 220—26.)

1. A buoyant deck for oil tanks comprising a plurality of pontoons of sector shape in horizontal section and having marginal walls extending upwardly to provide water pans, the pontoons being placed in a circular series to form a circular deck, and means for attaching the pontoons together.

1,665,111. Treatment of Lubricant Stocks. George Frederic Olson, Los Angeles, Calif., assignor to General Petroleum Corporation of California, Los Angeles, Calif., a corporation of Delaware. Filed Oct. 15, 1927. Serial No. 226,507. 5 claims. (Cl. 196—34.)

2. In the fractionation and purification of viscous pertoleum oils by treatment with liquid sulfur dioxid, the steps comprising: diluting said viscous oil with a light pertoleum solvent and adding to said diluted oil a sufficient quantity of a light pertoleum extractive obtained from a light pertoleum product.

1,664,977. Art of Distilling Lubricating Oils. Richard W. Hanna, Piedmont, Calif., assignor, by mesne assignments, to Standard Oil Company of California, San Francisco, Calif., a corporation of Delaware. Filed Oct. 4, 1923. Serial No. 666,475. 3 claims. (Cl. 196—77.)

2. In the art of petroleum distillation, heating the oil to be distilled to a temperature at which portions thereof would crack if maintained at such temperature for a period of time sufficient to permit the cracking reaction to take place, while maintaining the same in substantially liquid phase, immediately passing the heated oil before substantial cracking thereof take place to a vaporizing chamber, maintained under a reduced pressure less than atmospheric, wherein the temperature of the oil is dropped below the temprature at which portions would crack, extracting from the vapors the tarry "mist" without substantial scrubbing of vapors in said step, and thereafter fractionally condensing the vapors into a number of distillates of different boiling points.

1,665,022. Cooling Tower. Edward W. Cook, Los Angeles, Calif., assignor of one-half to Edward I. Field, Los Angeles, Calif. Filed April 27, 1927. Serial No. 187,016. 11 claims. (Cl. 189—12.)

1. A cooling tower having a plurality of louver units, corner structures connected to each unit, said corner structures of an upper unit resting on a unit next below.

REBUILD WAX HOUSE

Oil City, Pennsylvania.—Plans are under way for rebuilding, following the destruction by fire on April 3 of the wax house of the Crystal Oil Works at Rouseville, near here. The cause of the fire was not determined. The loss was between $25,000 and $30,000, but was covered by insurance.

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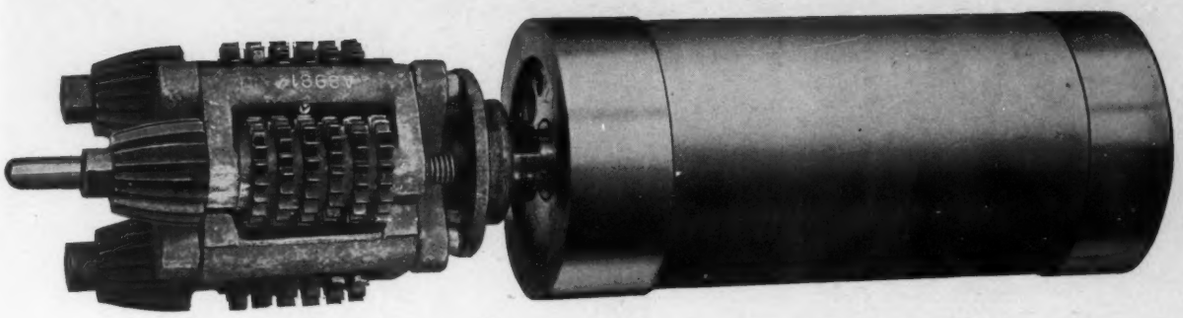

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Of The Refiner and Natural Gasoline Manufacturer published monthly at Houston, Texas, for April 1, 1928.

State of Texas, County of Harris.

Before me, a Notary Public in and for the State and County aforesaid, personally appeared A. L. Burns, who, having been duly sworn according to law, deposes and says that he is the General Manager of The Refiner and Natural Gasoline Manufacturer and that the following is, to the best of his knowledge and belief a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are:

Name of— Postoffice address—

Publisher—R. L. Dudley, 3301 Buffalo Drive, Houston, Texas.
Editorial Director—S. W. Robinson, 3301 Buffalo Drive, Houston, Texas.
Editor—Grady Triplett, Atco Bldg., Tulsa, Okla.
Managing Editor—J. Kent Ridley, 3301 Buffalo Drive, Houston, Texas.
General Manager—A. L. Burns, 3301 Buffalo Drive, Houston, Texas.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

James Anderson, Houston, Texas; R. L. Blaffer, Houston, Texas; Mrs. S. C. Blaffer, Houston, Texas; A. L. Burns, Houston, Texas; J. F. Carter, Jr., Tulsa, Okla.; Dr. N. L. Dudley, Goose Creek, Texas; R. L. Dudley, Houston, Texas; W. S. Farish, Houston, Texas; Dr. J. L. Gross, Houston, Texas; H. R. Hughes, Houston, Texas; Charles H. Lane, Houston, Texas; J. H. McEvoy, Houston, Texas; J. H. McEvoy, Jr., Houston, Texas; Wallace E. Pratt, Houston, Texas; J. Kent Ridley, Houston, Texas; S. W. Robinson, Houston, Texas; C. N. Scott, Houston, Texas; R. S. Sterling, Houston, Texas; John R. Suman, Houston, Texas; O. R. Waller, Chicago, Ill.; C. F. Williams, Humble, Texas.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:

Houston National Bank, Houston, Texas.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for who much trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

A. L. BURNS,
General Manager.

Sworn to and subscribed before me this 23rd day of March, 1928

(Seal) J. KENT RIDLEY.
(My commission expires June 3, 1929.)

PURE PUTTING IN STILL

Beaumont, Texts.—The Pure Oil Company is installing a new 10,000-barrel pipe still at its refinery at Smiths Bluff, Texas, to handle crude from its West Texas producing properties.

Price Oil Development and Refining Syndicate, operators of a skimming plant at Wainwright, Alberta, Canada, placed its second plant in operation during the early part of May, at Moose Jaw, Saskathewan. The company plans a third refinery to be erected at Vancouver, British Columbia.

BRECKENRIDGE GASOLINE PLANT

Ward Gasoline Company, at Breckenridge, Texas, has under construction a new absorption gasoline plant of the Newton type. Plant capacity is 6500 gallons. The plant will be in operation around June 1.